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MOVEMENT OF FUEL ASHORE: STORAGE, CAPACITY, THROUGHPUT, AND DISTRIBUTION ANALYSIS

by

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December 2015

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The Marine Corps' recent reemphasis on amphibious operations has identified a potential operational reach gap in the sustainment window of the Marine Expeditionary Brigade (MEB) in an undeveloped theater. This problem is defined by a limited capacity to move fuel ashore from tactical and seabased assets, coupled with increasing rates of end-user consumption. In the absence of host-nation support, sustaining the MEB during operations ashore requires joint interoperability of several fuel distribution systems and methods of resupply. The success of the seabased logistics network will depend on the use of a modern planning and forecasting approach. It is the aim of this study to understand the connection between the GCE's operational behavior and its fuel demand. This is accomplished through the use of the MAGTF Power and Energy Model to create a fuel usage data set. Subsequent regression analysis reveals key trends and provides insight into how operational decisions can result in marginal changes to fuel demand. Finally, this study examines the feasibility of fuel movement ashore using only the ship-to-shore connectors available to the MEB.

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The Marine Corps' recent reemphasis on amphibious operations has identified a potential operational reach gap in the sustainment window of the Marine Expeditionary Brigade (MEB) in an undeveloped theater. This problem is defined by a limited capacity to move fuel ashore from tactical and seabased assets, coupled with increasing rates of end-user consumption. In the absence of host-nation support, sustaining the MEB during operations ashore requires joint interoperability of several fuel distribution systems and methods of resupply. The success of the seabased logistics network will depend on the use of a modern planning and forecasting approach. It is the aim of this study to understand the connection between the GCE's operational behavior and its fuel demand. This is accomplished through the use of the MAGTF Power and Energy Model to create a fuel usage data set. Subsequent regression analysis reveals key trends and provides insight into how operational decisions can result in marginal changes to fuel demand. Finally, this study examines the feasibility of fuel movement ashore using only the ship-to-shore connectors available to the MEB.

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LIST OF ACRONYMS AND ABBREVIATIONS

A2AD	Anti-Access/Area Denial
AAV	Amphibious Assault Vehicle
ACE	Aviation Combat Element
ACV	Amphibious Combat Vehicle
AE	Assault Echelon
AFOE	Assault Follow On Element
ARG	Amphibious Ready Group
CBA	Capabilities Based Assessment
CE	Command Element
CEB	Combat Engineer Battalion
CLF	Combat Logistics Force
DoD	Department of Defense
DoE	Department of Energy
E2O	Expeditionary Energy Office
EF21	Expeditionary Force 21
FBCE	Fully Burdened Cost of Energy
FBE	Follow Behind Element
GCE	Ground Combat Element
H&S	Headquarters and Support
HQ	Headquarters
LAV	Light Armored Vehicle
LCAC	Landing Craft Air Cushioned
LCE	Logistics Combat Element
LCU	Landing Craft Utility
MAGTF	Marine Air Ground Task Force
MANA	Map Aware Non-uniform Automata
MASS	Mission Area Analysis Analytic Sustainment Suite
MCCP	Marine Corps Concept Paper
MCRP	Marine Corps Reference Publication
MCWP	Marine Corps Warfighting Publication

MEB	Marine Expeditionary Brigade
MEF	Marine Expeditionary Force
MEU	Marine Expeditionary Unit
MPEM	MAGTF Power and Energy Model
MPF	Maritime Prepositioning Force
MPSRON	Maritime Prepositioning Ship Squadron
NPS	Naval Postgraduate School
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OLS	Ordinary Least Squares
OM	Operating Mode
SC(X)R	Surface Connector (X) Recapitalization
SPMAGTF	Special Purpose Marine Air Ground Task Force
SPR	Strategic Petroleum Reserve
SSC	Ship-to-Shore Connector
TAMCN	Table of Authorized Material Control Number
UR	Utilization Rate
USMC	United States Marine Corps

I. INTRODUCTION

A. PURPOSE

The Marine Expeditionary Brigade (MEB) is doctrinally advertised as capable of self-sustainment for 30 days using only the supplies embarked on ship. In reality, this capability is overstated and has been more realistically estimated to be seven days (Expeditionary Energy Office, 2015). This 23-day shortfall is reportedly due to the limited capacity of ship to shore connectors coupled with a recent tendency to field equipment with decreased fuel efficiency. Across the force, increasing energy demands are the result of decisions to prioritize force protection over resource efficiency.

In an effort to close the sustainment gap and promote force extension, the Expeditionary Energy Office (E2O) has estimated that 17.5 percent of the aforementioned 23-day shortfall can be regained through changes in behavior alone (Expeditionary Energy Office, 2015). These changes may include, but are not limited to, the alteration of tactical plans, operating procedures, and force composition. Such alterations represent an acceptance of operational risk to buy down the foundational risk that the logistics network may be unable to sustain the combat forces. It is the purpose of this study to understand how the behavior of the MEB's Ground Combat Element (GCE) affects fuel demand and operational reach.

B. OBJECTIVES

As the Marine Corps Warfighting Publication entitled *Petroleum and Water Logistics Operations* notes, "Commanders and their staffs at all levels must be concerned about maintaining water and fuel support through completion of the unit's mission" (United States Marine Corps, 2005). The limitation of operational reach occurs when the system of suppliers fails to deliver on the fuel required by an end user. This forces the maneuver elements to culminate and lose the ability to be decisive of the battlefield. Decisions affecting this system carry significant consequence, and so this report aims to meet the following objectives in an attempt to contribute to logistical planning in support of future amphibious operations.

First, the connection between the GCE's operational behavior and its fuel demand must be established. This component of the MEB is comprised of several units, each with a unique set of equipment tailored to provide the capabilities required by their tasks. Changes to the employment, tactics, and procedures of these units, therefore, would uniquely affect their respective fuel demands. Identifying trends amongst these effects could provide insight into how certain units behave compared to one another and the system as a whole.

Second, this study seeks to identify changes to the GCE's behavior that would yield the greatest opportunity to affect operational reach. The equipment characteristics of a given unit within the GCE might lead it to be more heavily influenced by certain types of changes to its usage than others. Similarly, a given change may affect certain units differently than others based on their equipment profiles.

Third, force composition and amphibious landing plan alternatives is explored to identify opportunities to affect operational reach. The amphibious landing force is doctrinally tailored to accomplish its assigned mission in order to deliver an efficient, yet effective, force. This study will seek to identify how changes to the phased landing plan of the GCE may present opportunities to extend operational reach.

Last, this thesis research seeks to determine the adequacy of the MEB's connector capacity as it relates to fuel demand of the GCE. Given its advertised self-sustainment capability, the MEB must be able to move fuel ashore to its ground forces using organic assets. The feasibility of a fuel logistics network that is reliant on ship-to-shore connectors will be explored.

C. SCOPE

This study intends to discuss issues and challenges that may exist during a MEB amphibious landing in a non-permissive A2/AD threat environment using assets that will be available in 2024. According to recent doctrinal concepts, such as that described by Expeditionary Force 21, the MEB will be the “centerpiece of an expeditionary force in readiness”, and thus will be the focus of this report (United States Marine Corps, 2014, p. 14). These same concepts detail the need for a force that can assure littoral access despite considerable threats that seek to deny that ability. The principles of Operational Maneuver from the Sea, Ship-to-Objective Maneuver, and Seabasing offer guidance for operating in these threat environments and call for a tailored combat force ashore that is supported by a seabased logistics network (Department of the Navy, 1988; United States Marine Corps, 1996; United States Marine Corps, 2011). The majority of this discussion focuses solely on GCE fuel consumption without specific regard for the other MEB units and classes of supply that may impact logistics planning. Further limitations of the scope of this study are presented as applicable.

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II. BACKGROUND

A. STYLES OF WARFARE

While attrition warfare seeks to destroy the enemy's physical assets, the goal of maneuver warfare is to destroy the enemy's ability to function as a coordinated system. This style of warfare has fundamentally changed the way we approach enemy strengths and how we define their vulnerabilities. An attrition approach would regard an enemy's strength as something that must be addressed and defeated directly through the careful application of advantageous force ratios and combat power. The ability to coordinate and control efforts, therefore, is critical to our ability to have success against an enemy surface or strength. Accordingly, an attrition style lends itself to centralized control to coordinate the efforts of multiple arms to achieve the significant combat power necessary to destroy the enemy's critical assets. Success in attrition is defined in terms of enemy troops killed/captured, equipment destroyed, and territory controlled. The effort to sustain a force which aims to conduct this style of warfare prioritizes durability and capacity over speed and flexibility (United States Marine Corps, 1997b).

Maneuver warfare, on the other hand, centers around the careful identification and exploitation of the enemy's weakness based on our understanding of their system. It is intended to be accomplished through the use of speed, focus, surprise, and boldness. Success in maneuver warfare is defined by the inability of the enemy to act systematically (United States Marine Corps, 1997b). As the USMC Doctrinal Publication *Warfighting* summarizes,

> Maneuver warfare is a warfighting philosophy that seeks to shatter the enemy's cohesion through a variety of rapid, focused, and unexpected actions which create a turbulent and rapidly deteriorating situation with which the enemy cannot cope. (United States Marine Corps, 1997b, p. 73)

In future operating environments, the Marine Corps will continue to face many of the same challenges and obstacles that gave rise to the tenets of maneuver warfare. Our style of warfare must prioritize the ability to thrive in uncertain and dynamic environments where opportunities are short lived (United States Marine Corps, 1997b). Given the dichotomy between the American people's moral imperative to take action and their ever-shrinking appetite for prolonged conflict, Marines must be prepared to act both immediately and decisively. In short notice crisis response scenarios, Marines must be armed with a doctrine that allows them to "win quickly against a larger foe on his home soil with minimal casualties and limited external support" (United States Marine Corps, 1997b, p. 72).

B. EXPEDITIONARY FORCE 21

Published in 2014, EF21 provides vision and strategy for the Marine Corps in the twenty first century. It aims to provide goals and aspirations toward which the force can strive as it transitions from OIF/OEF with an eye toward addressing future operational challenges. EF21 and previous operating concepts reinforce the main missions of maintaining the abilities to respond to crisis and assure littoral access (United States Marine Corps, 2014). With over 80 percent of the global population living within one hundred miles of the coast, anti-access/area denial in the littorals is considered to be a rapidly growing global security threat (United States Marine Corps, 2014). The ability of the Marine Corps to fulfill its future mission requirements, therefore, relies on its ability to operate effectively in these areas.

To develop into a force with the necessary capabilities and capacity to succeed, EF21 sets forth a multi-faceted approach that aims to make the Marine Corps the "right force in the right place at the right time" (United States Marine Corps, 2014). Focus areas outlined in this approach include timeliness, scalability, and naval force integration. The forward posturing of one third of the operating forces will enable Marines to decrease the nation's crisis response time. Stressing the concept of scalability and tailoring forces to meet mission requirements is critical to avoiding wasteful excess that slows the force and decreases flexibility. Most importantly, the approach calls for naval force integration that will allow for effective maneuver and indefinite seabased sustainment. In short, EF21 works to reinforce the tenets of maneuver warfare and apply them to the future littoral combat environment in which Marines will be expected to succeed. It asserts that the force can develop the necessary capabilities through organizational refinement, forward posturing, increased naval integration, and enhanced littoral maneuver capability (United States Marine Corps, 2014).

C. OPERATIONAL MANEUVER FROM THE SEA AND SHIP TO OBJECTIVE MANEUVER

The importance of dominating the littorals was not a new concept in 2014, but rather EF21 served partially to reinforce earlier doctrine and concepts that had lost importance during the OIF/OEF years. In 1996, *MCCP 1–0 Operational Maneuver from the Sea* collected and synthesized these ideas to present a unified document that conveyed their importance to U.S. success in the face of future security challenges. Figure 1 is a summary of these principles.

Figure 1. Principles of Operational Maneuver from the Sea

Principles of
Operational Maneuver from the Sea

Operational Maneuver from the Sea focuses on an operational objective.

Operational Maneuver from the Sea uses the sea as maneuver space.

Operational Maneuver from the Sea generates overwhelming tempo and momentum.

Operational Maneuver from the Sea pits strength against weakness.

Operational Maneuver from the Sea emphasizes intelligence, deceptions, and flexibility.

Operational Maneuver from the Sea integrates all organic, joint, and combined assets.

Source: United States Marine Corps. *Operational maneuver from the sea (MCCP 1).* Washington, DC: Headquarters, Marine Corps, 1996.

The Marine Corps adapted these principles from maneuver warfare, applied them to the littorals, and later integrated them into EF21. The strength of these concepts lies in the opportunities they present by using the sea as an operational maneuver space. This allows our forces to gain advantageous positioning while simultaneously limiting the methods by which an enemy can challenge or threaten our position. In turn, the force is able to generate tempo and maintain momentum by quickly deploying significant combat power ashore across the globe. The sea is an area in which the U.S. enjoys a significant superiority in both equipment and competency. Operational Maneuver from the Sea presents numerous ideas for how we can leverage that advantage to apply the tenets of maneuver warfare across the globe.

The related concept of Ship to Objective Maneuver, originally published in 1997, provided additional ideas aiming to enhance Operational Maneuver from the Sea. Firstly, Ship to Objective Maneuver calls for the use of seabasing to limit the footprint ashore (United States Marine Corps, 2011). The idea is that the only forces that should go ashore are those specifically task organized to accomplish the given mission (United States Marine Corps, 2011). All other functions such as command and control, logistics, and fires should be kept at sea to the greatest possible extent (United States Marine Corps, 2011). By reducing the number of noncombat forces ashore, we limit the availability and ease with which the enemy may target friendly forces. Keeping these functions at sea provides a greater degree of protection and could eleviate certain political pressures. Secondly, the concept stresses the importance of force dispersion to avoid the adversary's ability to target and mass efforts on friendly forces. In the littoral environment, this means the use of multiple entry points and an emphasis on flexibility, speed, and decentralized coordination.

D. SHIP TO SHORE CONNECTORS

The physical act of moving personnel and equipment from the ship on which they are embarked to the shore on which they must fight is a complicated matter. The movement or maneuver of these assets must be accomplished through the use of landing craft, assault amphibian vehicle, or helicopters deployed from supporting ships. Each of these means of transportation carries with it vulnerabilities and limitations, but also unique advantages and strengths.

The effectiveness of helicopters is dependent on weather conditions, weight and range limitations, high fuel usage, and maintenance requirements. Additionally, while helicopters are capable of landing in unimproved areas ashore, landing at sea is restricted to certain ship decks with varying degrees of congestion. The advantages they provide, however, are that they provide speed and flexibility that surpass that of ground assets, the ability to bypass obstacles, and the ability to conduct operations when sea states prohibit the use of landing craft and amphibious vehicles (Department of the Navy, 1988). Their ability to transport supplies from source directly to user without the need for intermediate nodes makes them a more efficient means with regard to time and manpower.

In its current inventory, the Marine Corps uses the MV-22 and CH-53 as airborne connectors. The MV-22 Osprey is a tilt rotor aircraft capable of vertical take-off and landing. This capability grants it considerable employment flexibility as it can take off and land like a helicopter while reaching flight speeds typically seen in a fixed wing aircraft. As an airborne connector, this means that the MV-22 has a range that makes it capable of transporting personnel and supplies from an over the horizon seabase. This increased stand-off distance makes the seabase less vulnerable to various A2/AD threats. While the MV-22 is an effective mover of personnel and light equipment, its limited cargo capacity restricts its effectiveness in supply transportation operations (United States Marine Corps, 2000).

The CH-53E Super Stallion is currently being replaced by the CH-53K for use in the movement of heavy equipment and supplies from ship to shore. This platform follows a more traditional rotary helicopter design and thus has a more limited range and over the horizon capability as compared to the MV-22. What it lacks in range, however, it makes up for by having almost triple the cargo carrying capacity as compared to the Osprey (United States Marine Corps, 2015). A more detailed summary of the specifications of both airborne connectors can be found in Appendix D.

Waterborne ship to shore movement takes place via various classes of landing craft. In its current inventory, the Marine Corps employs the LCU and LCAC. These small vessels are limited by sea state conditions, the suitability of the coastline and beaches for landing, anti-access obstacles like mines, and the availability of well deck space. Landing crafts, when compared to airborne assets, provide increased fuel efficiency and cargo capacity but fall short in speed and flexibility of employment. The replacement of both of these platforms is imminent. The SC(X)R is projected to replace the LCU in 2222. The SSC is projected to replace the LCAC in late 2020. Both replacements are upgrades aimed at improving capability to fit the future needs of the force while driving down long term operations and support costs (Eckstein, 2015).

Together, a mix of both surface and air methods to support ship to shore movement builds a limited degree of resiliency into the system. Both methods, however, are vulnerable to weather and highly correlated fluctuations in sea state (Department of the Navy, 1988).

E. OVER THE SHORE LOGISTICS

In practice, the movement of supplies, equipment, and personnel from ship to shore has been accomplished on many occasions with varying degrees of success. Historically, our ability to sustain the combat forces ashore has entailed the offloading and build-up of all classes of supply at ports. For the most part, this has proven to be a long arduous process that often required port improvement and construction efforts. Logisticians then focused on stockpiling and staging as much as possible ashore to meet the considerable needs of the maneuver forces as they sustained combat operations. In effect, this process created a huge logistical footprint, which is often referred to as an “Iron Mountain” (Born, 1998). This sort of large stagnant storage area is undesirable for two main reasons.

First, it represents a considerable security challenge, which the commander must address by tasking combat forces to protect the logistics staging area (United States Marine Corps, 1996). This detracts from the force's ability to act decisively elsewhere in the area of operations and thus it may inherently damage the likelihood of tactical success. Second, a great deal of time, resources, and effort are expended in building the "Iron Mountain." The quantity of goods moved ashore is prioritized over the actual needs of the maneuver elements, resulting in a certain degree of effort which adds no value to the forces' ability to accomplish the given mission (United States Marine Corps, 1996). As summarized by *Operational Maneuver From The Sea*,

> For most of the 20th century, the usefulness of sea-based logistics was limited by the voracious appetite of modern landing forces for such items as fuel, large caliber ammunition, and aviation ordnance. As a result, the options available to landing forces were greatly reduced by the need to establish, protect, and make use of supply dumps. Concerted efforts were delayed and opportunities for decisive action missed while the necessary supplies accumulated on shore. (United States Marine Corps, 1996, p. 5)

The concept of Over the Shore logistics, attempts to remove this sort of inefficiency that detracts from the accomplishment of the supported objective(s). By conducting logistics "over the shore" rather than "to the shore," the force can avoid the necessity for an "Iron Mountain" by distributing the necessary goods closer to the end user. Ideally, supplies could be delivered directly from the source to the end user for consumption. The elimination of intermediary nodes from the system would greatly enhance efficiency and timeliness while reducing security concerns and vulnerability.

F. SEABASING

To perform Operational Maneuver from the Sea and Over the Shore Logistics, we must continue to understand, execute, and develop the seabasing techniques that make them possible. Seabasing seeks to reduce the necessity for a large footprint ashore, eliminate reliance on port infrastructure, and avoid many of the political restrictions on what can or cannot be done on other nations' sovereign land (Department of the Navy, 2010). It works to relocate, to the greatest extent possible, the proverbial "Iron Mountain" from the vulnerable shore to the relative security of a network of platforms such as Carrier Strike Groups, Amphibious Readiness Groups/Marine Expeditionary Units, Expeditionary Strike Groups, Amphibious Forces, and Maritime Prepositioning Ships Squadrons (Department of the Navy, 2010). Through the placement of these assets and resources aboard ships, the Combat Service Support Area becomes a mobile distribution network capable of providing sustainment while tailoring its method and route of delivery. In addition to sustainment capability, effective seabasing is capable of at sea transfer, selective offload, austere access, command and control, force projection ashore, maritime strike, seabase defense, intelligence, surveillance and reconnaissance, and medical support (Department of the Navy, 2010). All of these functions previously required a significant number of troops and equipment ashore, adding to the Combat Service Support Area footprint.

The effectiveness of seabasing is largely dependent on the quality of information that is being communicated and acted upon. Despite its many downsides, a large footprint ashore allows for resiliency in the face of uncertainty and demand fluctuations. If a maneuver unit were to experience an immediate unforeseen need for a given class of supply, they have the comfort of knowing that the supplies are available using proven ground transportation networks. This describes the characteristics of a "push" logistics system in which supplies are sent forward based on projected requirements (United States Marine Corps, 1997a). When sustainment is coming from the sea, however, these maneuver units must accurately communicate the supplies that they need. This will require the integration of a naval total asset visibility or common logistical picture system in which end user demand is quickly and accurately communicated to the seabase suppliers (United States Marine Corps, 2014).

To be successful, the strengths of both approaches must be leveraged. The resiliency afforded by maintaining a readily accessible inventory ashore is advantageous in the face of dynamic demand rates. Such an inventory should not be so large, however, so as to represent a significant vulnerability. Conversely, the flexibility and security afforded by seabased sustainment is advantageous in that it magnifies the availability of combat power dedicated to the mission, untethers the user from traditional lines of communication, and permits the use of tempo and speed to seize initiative in combat.

Similar to the nature of the styles of war (attrition and maneuver), the methods of sustainment cannot exist in a pure sense. A purely seabased approach with no inventory ashore is extremely vulnerable in the face of weather and sea state fluctuations, for example. As the maneuver forces project further inland, this effect grows as airborne connectors must travel greater distances and surface connector landing sites are further from the end users. An appreciation for the strengths and weaknesses of logistical approaches is fundamental to building a system which supports and compliments the maneuver element that is accomplishing the assigned mission.

G. OPERATIONAL REACH

As defined by the Army's FM 3–0 Operations, operational reach is "the distance and duration across which a unit can successfully employ military capabilities" (Department of the Army, 2008, p. 6.15). The ability to employ military capabilities across a given distance is much more than simply being present in a given geographical area. It implies that the force has the assets and resources necessary to take the actions necessary to ensure success upon arrival. The duration component of the definition signals that if the force is unable to sustain its activities indefinitely, its operational reach is inherently limited.

Maneuver warfare and the methods of sustainment in support of amphibious operations that have been previously discussed all aim, in some way, to extend operational reach. Every military commander throughout history has wished that his or her force were able to move faster and further while fighting harder for longer. Exhaustive planning and operational design can extend operational reach through tempo management and phasing approaches. Examples of technological innovation's effect on operational reach throughout history are abundant. While technological developments, such as air assets, have allowed our forces to extend the distance component of operational reach, they are limited by the duration component. An aircraft may be able to travel hundreds of miles, but without consistent fuel resupply it is unable to successfully employ military capabilities upon arrival. On the other hand, a thin-skinned and fuel efficient troop carrier might be able to travel a great distance relatively quickly. However, without adequate force protection measure like armor it too may be unable to employ military capabilities upon arrival. A heavily fortified tank with an impressive weapon system will certainly be able to provide impressive combat power, but will be severely limited in distance and duration measures. These three components of operational reach (distance, duration, and capability) are in constant contention and thus require tradeoffs be made between them to arrive at a level of operational reach that satisfies the overall mission requirements.

H. MARINE AIR GROUND TASK FORCE CONCEPT AND EMPLOYMENT

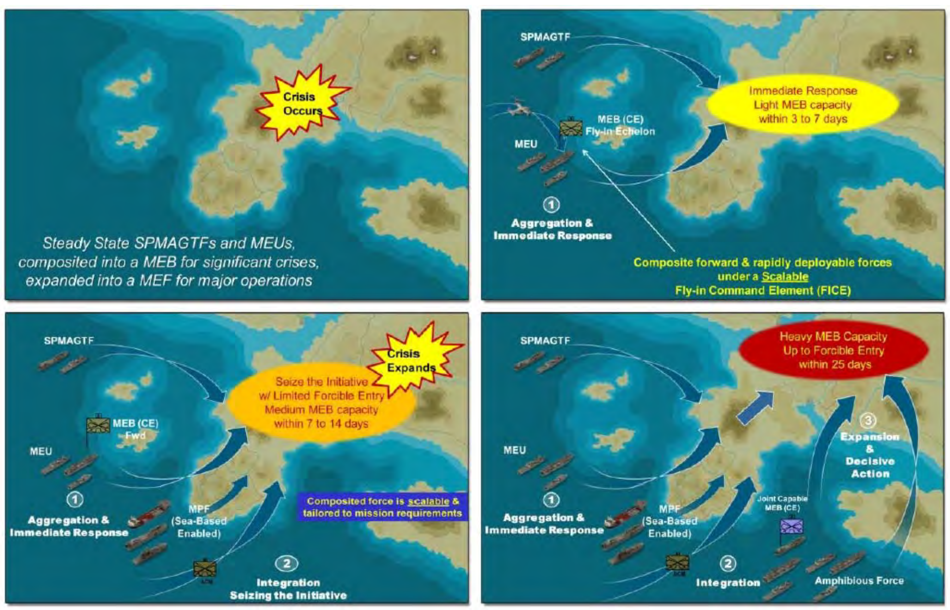
Expeditionary Force 21 sets forth a new vision for the employment of Marine Air Ground Task Forces. Traditionally, in response to a significant crisis, Marine Expeditionary Brigades would embark aboard amphibious shipping and move to the area of operations. Once in theater, they would combine with prepositioned assets and fight as a Marine Expeditionary Force (United States Marine Corps, 2014). This concept was executed in Operation Desert Shield/Desert Storm and Task Force 58 to deliver a formidable force with extensive capabilities in support of major campaigns (United States Marine Corps, 2014).

Moving forward, however, Expeditionary Force 21 strives to deliver more scalable, flexible, and forward postured response capabilities to the respective Geographic Combatant Commander. To that end, it seeks to constitute MEBs forward from Special MAGTFs and Marine Expeditionary Units already deployed. As summarized by *Marine Expeditionary Brigade Concept of Operations*,

> Deploy as SPMAGTFs and MEUs for steady-state engagement activities and crisis response, composite forward into a MEB for more significant crises and contingencies, expand the MEB into a MEF to fight major operations and campaigns. (United States Marine Corps, 2014, p. 24)

This sort of organizational focus on a scalable response capability will drastically shorten reaction time when necessary. It prioritizes a tailored response to deliver a force best suited to defeating the given threat. This operational design, as depicted in Figure 2, will serve to not only reduce response time, but also provide some extension of operational reach.

Figure 2. Compositing and Employing the Scalable MEB



Source: United States Marine Corps. (2014). *Expeditionary force 21, forward and ready: now and in the future.* Washington, DC: Headquarters, Marine Corps.

I. AMPHIBIOUS READY GROUP AND MARINE EXPEDITIONARY UNIT

The Amphibious Ready Group/Marine Expeditionary Unit is an “integrated naval formation primarily designed as a highly mobile, versatile, and self-contained crisis response force” (Department of the Navy, 2014, p. 1.1). As such, the MEU is embarked aboard the three ARG ships to meet the required capabilities. Despite their advertisement as a “self-contained crisis response force,” the ARG/MEU concept assumes the logistical support of the Navy’s combat logistics ships. The following represent the typical composition of these forces.

Amphibious Ready Group:

- An Amphibious squadron commander and associated staff
- Multipurpose or general purpose amphibious assault ship (LHA/LHD)
- An amphibious transport dock (LPD)
- A dock landing ship (LSD)
- Navy force enablers (naval beach group detachment, beach part teams, etc.)

Source: Department of the Navy. (2014). Disaggregated amphibious ready group/marine expeditionary unit concept of employment. Norfolk, VA: Department of the Navy.

Marine Expeditionary Unit:

- Command Element
- Ground Combat Element
- Aviation Combat Element
- Logistics Combat Element

Source: Department of the Navy. (2014). Disaggregated amphibious ready group/marine expeditionary unit concept of employment. Norfolk, VA: Department of the Navy.

Traditionally employed as a single entity, the ARG/MEU is certified to execute the following range of missions:

- Amphibious Assault
- Amphibious Raid
- Visit, Board, Search and Seizure
- Noncombatant Evacuation Operations
- Foreign Humanitarian Assistance/Disaster Relief
- Stability Operations
- Tactical Recovery of Aircraft and Personnel
- Joint and Combined Operations
- Theater Security Cooperation
- Airfield/Port Seizure
- Advanced Force Operations
- Aviation Operations from Expeditionary Shore Based Sites

Source: Department of the Navy. (2014). Disaggregated amphibious ready group/marine expeditionary unit concept of employment. Norfolk, VA: Department of the Navy.

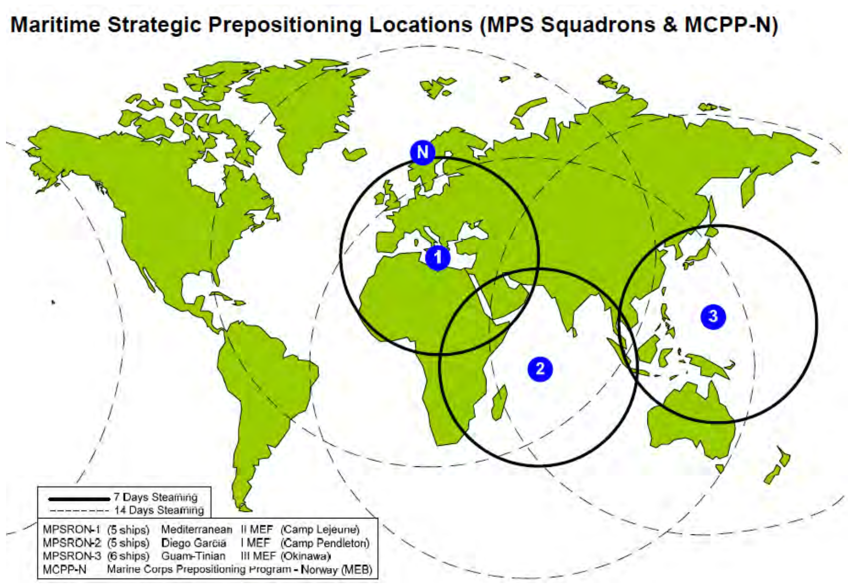
The ability to have such an extensive range of capability forward positioned is a valuable asset to the geographic combatant commander. Particularly when married with the Expeditionary Strike Group, the concept provides a crisis response force that is both capable and credible.

Occasionally, geographic combatant commanders have found it advantageous to disaggregate, or split, the ARG/MEU forces. While this is not the preferred method of employment, it may allow for the simultaneous accomplishment of smaller missions which pose lesser risk to the force. A disaggregated force will not carry with it the full spectrum of capabilities and will require additional supporting assets. Thus, the decision to disaggregate the ARG/MEU is intended to be temporary rather than a static state of operations (Department of the Navy, 2014).

J. MARITIME PREPOSITIONING FORCE

Given the updated MAGTF concept of employment in which MEBs will be composited forward, prepositioned equipment and capabilities will play a major role in reducing reaction time and sustaining the force. The Maritime Prepositioning Force is a critical component of our ability to maintain a forward posture while remaining capable of considerable power projection when necessary. The basic unit of the Maritime Prepositioning Force is the Maritime Prepositioning Ship Squadron (MPSRON). Three such squadrons are consistently afloat near the Mediterranean, Diego Garcia, and Guam. Together, the MPSRONs are composed of 16 ships that are broken into the three squadrons (Figure 3) (United States Marine Corps, 2004).

Figure 3. Location of MPSRONs



Source: United States Marine Corps. (2010). *MAGTF planner's reference manual.* Quantico, VA: MAGTF Staff Training Program.

In the past, the role of MPF assets was to augment and enable the MAGTF in its amphibious operations, specifically in the construction of the logistical footprint ashore (United States Marine Corps, 2004). With the improvements and focus on seabasing, however, they become an integral part of seabasing operations. With considerable, and ever-improving, off-load/on-load capabilities, planners intend to use these platforms as everything from troop berthing and planning spaces to flight decks and warehouses (United States Marine Corps, 2014). In principle, the “Iron Mountain” of traditional amphibious logistics support will be relocated aboard the MPSRON and ARG ships to form the seabased combat support staging area.

K. BULK FUEL SYSTEMS

Among the greatest limiting factors of operational reach is fuel. It is often described as the “tether” or “leash” that limits the progress of the maneuver elements (Baas, 2012). This effect is continually magnified as the MEB grows heavier and more powerful. The delivery of fuel from seabase to the end user poses unique challenges that differ from the delivery of other classes of supply. As Marine Corps Order 3900.19 asserts,

> seventy percent of the logistics required to sustain Marine Corps expeditionary forces ashore is fuel and water. A Marine infantry company today uses more fuel than an entire infantry battalion did in 2001. This increase in demand for “liquid logistics” constrains operations. (United States Marine Corps, 2013, p. 1)

As a liquid, transporting fuel typically requires a vessel, tank, or container in which to be transported. When transported in discrete increments, the movement of any sizeable amount of fuel requires exhaustive effort and a high volume of transportation assets. Every effort, therefore, is made to move fuel in bulk. The development and use of pipeline systems has proven effective, but only over finite distances.

In support of MEB amphibious operations in a non-permissive littoral environment with significant anti-access/area denial threat, the risk associated with the preferred method of bulk fuel transportation via pipeline is likely to prove unacceptable. The threat of mines and/or anti-ship cruise missiles is likely to be significant in any future littoral combat environment (United States Marine Corps, 2014). Anchoring a ship, like the Off-Shore Petroleum Distribution System, right off the coast while it pumps the necessary fuel to an inland storage facility is too risky. This sort of operation would only be feasible in an extremely permissive environment where the threat ashore is sufficiently nullified. As documents like Expeditionary Force 21 illustrate, future conflict response scenarios will likely be chaotic, uncertain, and asymmetric (United States Marine Corps, 2014). A plan to support MEB operations ashore from a seabasing platform, therefore, must be executable in such an environment.

Accordingly, the same airborne and waterborne connectors used to transport and distribute the other classes of supply must have the capability to move fuel to the end users. A variety of unique drums, bladders, and pump systems exist with limited interfacing capability and interoperability. These systems, while innovative, lack the capacity to efficiently resupply and sustain the forces ashore. Even with the most innovative solutions, the capacity of connectors to provide fuel to the maneuver force is unable to match the efficiency with which a pipeline system can operate. There exists a mismatch between the desire of the maneuver commander to execute operations in accordance with the principles of maneuver warfare and the ability of the logistician to distribute fuel to him in a similar fashion (Perry, Euller, Kavanagh, & Salcedo, 2012).

III. LITERATURE REVIEW

Numerous studies and various research methods have focused on the issues surrounding the Marine Corps' vision for efficient operational logistics in support of amphibious operations. This has resulted in a relatively comprehensive approach to a complex system and its associated challenges. As doctrinal concept and technological innovation progress, it is critical that these efforts continue to help understand and mitigate these challenges and meet the given operational requirements.

A. MAGTF LIFT AND DISTRIBUTION CAPABILITY

The Marine Corps' Logistics Vision and Strategy Branch recently sponsored a two year study to analyze the capacity of current and future MEUs to meet the logistical lift and distribution capabilities of ship-to-shore connectors as demanded by the EF21 concept. To that end, the study first needed to establish a baseline table of equipment around which it could center further analysis. After collecting the available data from 11 MEUs between May 2009 and August 2013, the study found the data to be "not suitable for studying logistics capabilities" (United States Marine Corps, 2015, p. iii). This is indicative of a service wide, perhaps DoD wide, shortfall in established data collection practices. Without complete historical data the study found that the best approach would be to composite an EDL based on 2024 MEU baseline as established by the Annual Report for Afloat MAGTF Requirements (United States Marine Corps, 2012).

Overall, the study aimed to accomplish three primary objectives. Primarily, it aimed to determine the adequacy of MEU lift and distribution capabilities. Given a realistic situation the study undertook an extensive modeling effort that summarized the MEU's ability to internally meet its sustainment requirements. Second, the study worked to identify potential gaps and shortfalls between current capabilities and those required by EF21. Finally, recommendations were made regarding the development and implantation of planning tools to support amphibious operational logistics (United States Marine Corps, 2015).

The modeling effort was conducted using a suite of five models known collectively as the Mission Area Analysis Analytic Sustainment Suite (MASS). Using the data from each model to feed into the others allowed for the development of sustainment requirements, intermodal supply embarkation plans, and finally ship-to-objective delivery plans. The lift and distribution study concluded that the MEU had sufficient lift capability to meet the demands of the EF21 concept, but only when the logistics network and assets were managed correctly. When employed appropriately, MASS "enables the analyst to; rapidly identify the time required to complete a movement, the number of connectors by type required, and the effects distance and container type/number have on the mission" (United States Marine Corps, 2015, p. 13).

One of the key shortfalls identified by the lift and distribution study is the lack of use and availability of tools like MASS to amphibious logistics planners in the operating forces (United States Marine Corps, 2015). The study does find, however, that the use of MASS is valuable once given the availability of force data such as number of personnel, equipment quantities by specific type, and fuel and water consumption factors (United States Marine Corps, 2015). With respect to fuel consumption, the lift and distribution study states the planning assumption of all vehicles operating at eight hours per day. The quality of this input data, therefore, will affect the usability of the output landing plans.

B. REDUCTION OF FUEL EFFORTS

Additional efforts have been made to study the way ship-to-shore connectors use fuel with the aim of "improving energy efficiency of a MEB during an amphibious landing prior to an A2AD mission" (Super Group Cohort 311-122O, 2013, p. xix). When operating in a non-permissive environment, the availability of bulk fuel that can be used in support of the landing force may be limited. One way to mitigate this challenge is to reduce the fuel used to deliver troops, supplies, and equipment ashore in order to make more available for maneuver units.

The work conducted at the Naval Postgraduate School by Super Group Cohort 311–122O concluded with several important findings. Primarily through a discrete event modeling approach, the study found that fuel savings were directly proportional to seabase distance and sea state (Super Group Cohort 311-122O, 2013). Additionally, it identified the LCAC and MV-22 as having “the most significant negative effects on overall fuel efficiency during the mission” (Super Group Cohort 311-122O, 2013, p. xxiv). On the other hand, it acknowledges the benefits of the LCAC during the amphibious assault phase due to its unique flexibility of employment in an A2/AD environment (Super Group Cohort 311-122O, 2013). Ultimately, the study recommends the mitigation of fuel inefficient practices through “operational workarounds, such as decreasing Seabase Standoff Distance, and employing LCUs in place of LCACs” (Super Group Cohort 311-122O, 2013, p. xxiv).

C. SEABASED OPTIMIZATION EFFORTS

In light of the lift and distribution capacity, as well as fuel availability restrictions, several efforts have been made optimize the seabased sustainment system. Such efforts are often limited in scope and affected by the aforementioned unavailability of complete data of high quality (United States Marine Corps, 2015). The importance of seabased logistics as an area of study was downgraded during the wars in Iraq and Afghanistan. In the late 1990s, however, STOM and SeaBasing were being embraced as concepts critical to the future success of the Marine Corps. During that time period, several studies centered on concerns about the MAGTF’s ability to sustain operations ashore.

A 2001 study conducted at NPS, for example, aimed to assess the ability of an LHD class ship to meet the various supply needs of a force ashore using a ship to objective design. The study models and simulates a seabased logistics network and analyzes its ability to meet the demands of the force during three operational scenarios. The results found that “a substantial increase in the number of aircraft, operational availability of those aircraft, and/or a substantial reduction in sustainment requirements are needed in order to successfully accomplish the stated scenarios” (Bryan, 2001, p. v).

Recently, studies that center on the effectiveness of amphibious operations have once again increased in frequency and importance as a result of the drawdown of forces from Afghanistan and Iraq. One such study, conducted at NPS in 2015 aimed to inform the development and employment of future combat systems using a combat simulation approach of an amphibious raid scenario (Parker Jr., 2015). The author’s findings make strong arguments for the increased use of self-deploying systems like AAVs (or perhaps the future ACVs) while also identifying practices that would, in effect, result in significant fuel cost savings (Parker Jr., 2015). Through the use of a combat simulation approach, the author’s analysis is made credible and relevant by its focus on success on the battlefield.

D. OPERATIONAL AND STRATEGIC LEVEL

For any amphibious force to be supported, the larger naval and defense logistics networks must function efficiently. The Combat Logistics Force (CLF) is the U.S. Navy’s worldwide sustainment fleet. Thorough optimization efforts, like that conducted by Brown & Carlyle in 2008, aim to ensure that the CLF is capable of supporting combatant ships and thus remove the necessity for them to return to port. The insight gained from CLF models is also valuable in the systems acquisition process as it informs ship capability and requirement decisions.

The U.S. also maintains a Strategic Petroleum Reserve (SPR) through which it manages several stockpiles across the globe. Numerous studies have sought to optimize the location and quantity of petroleum products that are being held with regards to operational planning and global markets (Teisberg, 1981). Others have debated the very existence of the SPR, arguing that the high maintenance and acquisition costs far outweigh the overstated benefits (Taylor & Van Doren, 2005).

The efficient management of large networks like the CLF and SPR represent opportunities for DoD and DoE planners to extend the operational reach of the U.S. military as a whole. These calculations are ultimately the product of lower level fuel demand signals.

E. FULLY BURDENED COST OF ENERGY

Since 2011 the inclusion of the Fully Burdened Cost of Energy (FBCE) in calculations which support of acquisition decisions has been mandatory (Doerry, 2013). This cost is the product of uniform methods developed by the various System Commands (Doerry, 2013). The calculations proposed by Doerry in 2013 work to accurately calculate the FBCE as it relates to surface ships. It relies primarily on annual energy usage and operational profile development, to include the fuel consumed by embarked vehicles and equipment (Doerry, 2013). Errors or inaccuracies that are made at even the lowest level of energy planning could be compounded into some of the nation's largest acquisitions considerations.

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IV. METHODOLOGY

A. RESEARCH QUESTIONS AND APPROACH

Primary Question:

What is the relationship between the GCE’s operational behavior and its fuel consumption?

Given the limited capacity of ship to shore connectors to move bulk fuel in a non-permissive littoral environment, the logistics network supporting the EF21 concept must be managed intelligently to meet demand. Currently, as noted by the MAGTF lift and distribution study, “there is a complete lack of logistics planning and execution tools in the operating forces” (United States Marine Corps, 2015). The study concludes that, given complete and accurate data, MASS represents the sort of tool that can help manage the complex EF21 logistics network (United States Marine Corps, 2015). In order to further address this research question, this study aims to evaluate one method by which the input data can be improved with respect to fuel demand. The quality of the landing and support plans is a direct reflection of the integrity of the input data. Through the use and application of MPEM, planners may be able to improve the accuracy with which they forecast fuel usage over the course of operations ashore. Once the strengths and limitations of MPEM are understood, significant conclusions may be drawn about how operational decisions can result in marginal changes to fuel demand. This insight may help decision makers and logistics planners to better understand tradeoffs between operational and foundational risk.

Secondary Questions:

1. What changes to the GCE's behavior would yield the greatest opportunities to increase the MEB's operational reach?
2. What force composition and amphibious landing plan alternatives present opportunities to increase the MEB's operational reach?
3. Do the MEB's connectors have sufficient capacity to support the fuel demand of the GCE ashore?

B. MAGTF POWER AND ENERGY MODEL

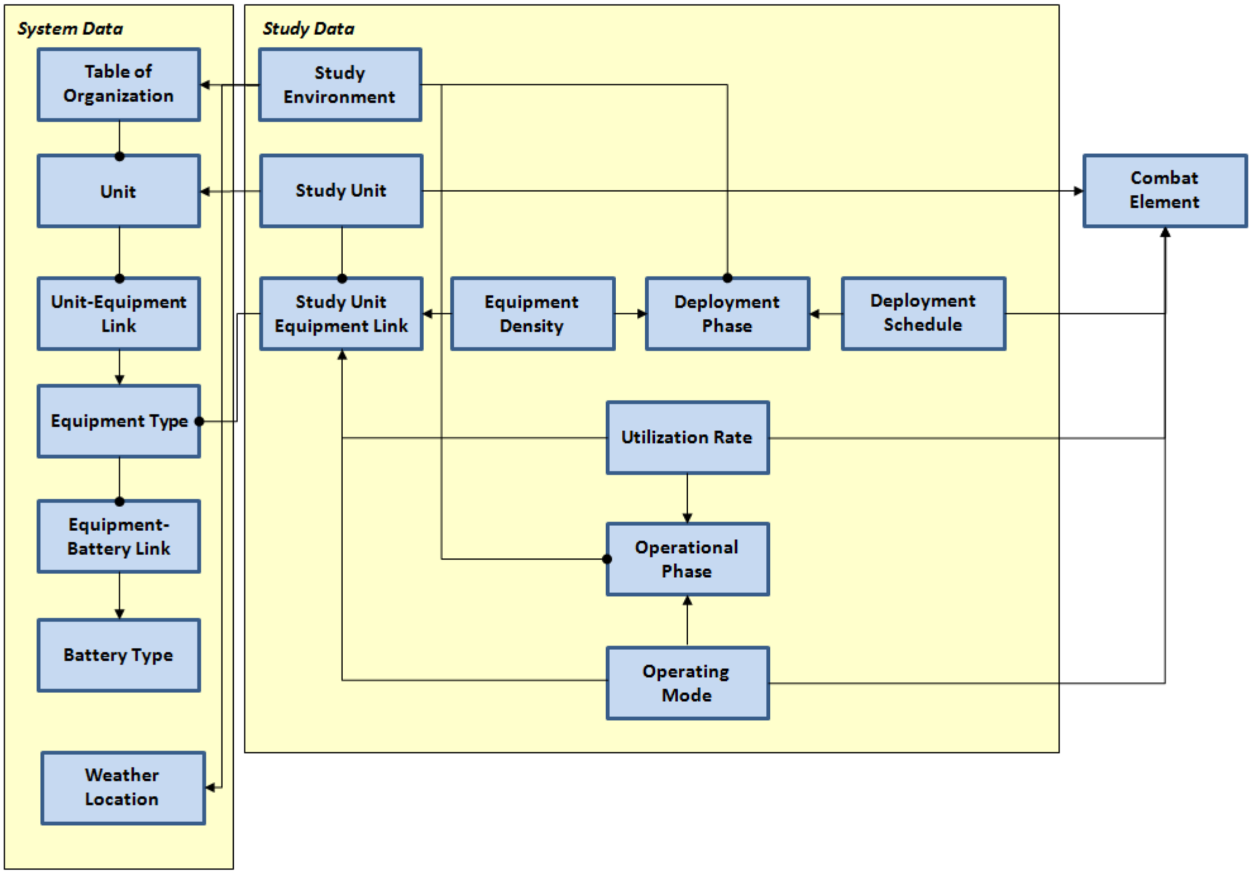
1. Description

Written in Visual Basic for Applications and embedded in Microsoft Excel, MPEM is a deterministic modeling tool. It calculates the fuel consumption and electrical consumption/generation of an operational unit over time. The model is customizable and can be tailored to reflect just about any MAGTF operational scenario. The integration into the Microsoft Excel platform means that it can be used with ease by users of varying technical abilities. In comparison to the planning factors and ad hoc methods that are commonly used in the operating forces, MPEM offers a more comprehensive and detailed approach to forecasting energy demand (Group W, 2014).

2. Input Data

As shown in Figure 4, MPEM driven by a data that belongs to either the system or study category. In general, the system data refers to the technical specifications of equipment and the composition of units involved. Study data, on the other hand, is composed of operational data such as deployment information and operational activity (Group W, 2014).

Figure 4. MPEM Data Structure



Source: Group W. (2014). *MAGTF power & energy model (v3.1) user's guide.* Washington, DC: Author.

a. *System Data*

(1) Tables of Organization

The user is able to upload or build a set of units that will consist of the operating forces for the model. Once established, each unit is assigned the appropriate equipment and personnel which will define its unique energy usage characteristics. The units can later be sorted and filtered by combat element (CE, GCE, ACE, etc.) or function (infantry, artillery, tanks, etc.) for analytical purposes. Only the equipment and personnel assigned to a unit will impact its energy usage calculations. The element or function to which a unit is assigned will not impact its energy usage. This information is categorical in nature but it does not assume anything about the operational differences between units of different functions (Group W, 2014).

(2) Equipment

Similar to the tables of organization, MPEM allows the user to upload or build a database of equipment that can be assigned to the operational units. Each equipment type, commonly identified using the alphanumeric TAMCN, will not affect energy demand until it is attached to a unit. Each equipment type is defined by thirty different attributes that will define its energy profile. For purposes of this study, a few important attributes are described in Table 1 (Group W, 2014).

Table 1. MPEM Equipment Attributes

Gallons Per Hour Base	Gallons of generic fuel consumed by the equipment per hour.
Kilowatt Base	Electrical consumption of the equipment per hour. This affects fuel usage indirectly as equipment that consumes electricity, but not fuel, will impact the calculations used for power generating equipment and battery use.
Percent Use	Percentage of the equipment that is deployed that is in daily use. Changes to the percent use attribute can be used to reflect typical maintenance rates, etc.
Hours Per Day	Defines the number of hours that the equipment is operating in a given 24 hour period. This can be considered as part of operational tempo in that the more active a unit is, the more hours per day its equipment will be operating.
Percent Low Operating Mode	Many equipment types consume energy at much different rates depending on if they are running in low or high operating modes. For example, laptops can go into sleep mode and vehicles can idle in order to save energy. This too can be interpreted as a component of operational tempo as the more a unit fights, maneuvers, or even processes information, the less its equipment is in low operating mode. The ratio of fuel used in low and high modes is also among the equipment attributes.

Source: Group W. (2014). *MAGTF power & energy model (v3.1) user's guide.* User's Manual, Washington D.C.

(3) Weather

Weather data (low/high temperature and hours of sunlight) is included as input data because of the impact that temperature has on energy demand. Specifically, the model accounts for increased requirements for power generation when the temperature falls outside of the desired range (Group W, 2014). Among the many equipment attributes are gallons per hour and kilowatts per hour consumed by environmental control units used for heating or cooling. The model does not account, however, for the effect of air conditioning or heating in vehicles on fuel consumption (Group W, 2014).

b. Study Data

(1) Operational Phases

The level of activity for the landing force and its logistics network depends largely on the operational phase. For example, the GCE will not use fuel at the same rate when it is conducting stability operations as when it is gaining a foothold. Accordingly, MPEM allows for the establishment of operational phases which can be given durations and unique equipment usage attributes. For purposes of this study, three operational phases were established; forced entry, surge, and sustain. The attributes of each phase were then altered to create more realistic data.

(2) Deployment Phases

Similarly, MPEM is designed to reflect MAGTF operations in which the force is phased ashore over time. These deployment phases can be likened to waves, echelons, or time periods in which certain units and their respective equipment is moved from ship to shore. Accordingly, a unit will not begin consuming fuel until it has been deployed. For purposes of this study, three deployment phases were established; Assault Echelon, Assault Follow-On Echelon, and Follow Behind Element. For a given unit in a given phase, its personnel and equipment is assumed to arrive at a constant rate throughout that phase, with 100 percent of its assets ashore by the end of the deployment phase. For example, a company assigned to a deployment phase with a duration of four days would have 25 percent of its assets moved ashore each day.

3. Strengths and Limitations

The value of MPEM lies in its ability to account for a variety of technical characteristics and apply them in an operational context. Its approach is far more detailed than the alternative methods that have been used previously. The relative simplicity of the Microsoft Excel interface makes it a feasible tool for logistics planners in the operating forces. With minimal training and exposure, a Marine could customize MPEM to his/her unit and use it to forecast their unit's fuel usage during its next training evolution or combat operation. On a grander scale, the output from an adequately constructed and maintained MPEM file can provide high fidelity data which, when used in conjunction with a tool like MASS, could result in a landing and support plan that mitigates many of the challenges associated with EF21 logistics.

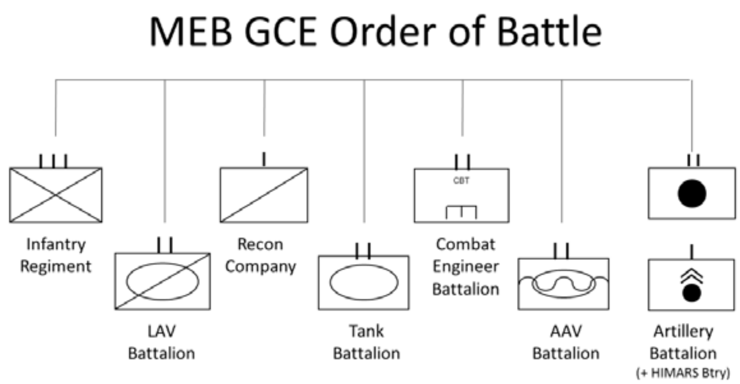
As a deterministic model, MPEM does not allow for the variation that will inevitably occur in real life operations. Applying a flat value for the hours per day that a certain equipment type will be used, for example, is unrealistic. Planners would be better aided by a tool that enabled them to understand the probable range of fuel demanded. With a stochastic model, one could establish, with a degree of confidence, a forecast for the quantity of fuel used during an operation. Due to its deterministic nature, MPEM only provides a single point estimate based solely on the input data.

C. ORDER OF BATTLE

Similar to the use of a 2024 MEU baseline in the MAGTF Lift & Distribution study, a 2024 MEB baseline has been established and used in various studies and war gaming exercises (United States Marine Corps, 2012). This study uses the 2024 MEB Baseline GCE, as constructed by Group W in MPEM, as the basis for analysis. In keeping with the spirit of EF21 and seabasing concepts, this approach assumes that all other combat elements are either operating from the sea or being supplied from a separate logistics network that does not involve ship to shore connector support.

As depicted in Figure 5, the units that compose of the 2024 MEB Baseline GCE and thus represent the end users throughout this study. Not represented in Figure 5, but included in the GCE, is a small Division Headquarters Detachment which provides various ancillary support services outside of typical logistics functions such as chaplain, medical, and military police functions.

Figure 5. MEB GCE Order of Battle Demanding Connector Support.



A comprehensive list of the equipment assigned to each of these units can be found by accessing the USMC Total Force Structure Management System. Collectively, these units, with their respective personnel and equipment, represent the combat power that must be landed and supported ashore during an amphibious assault operation. In an ideal EF21 amphibious assault operation, these units would draw supplies directly from ship to shore connectors without the need for a robust LCE footprint ashore.

D. EXPERIMENTAL DESIGN

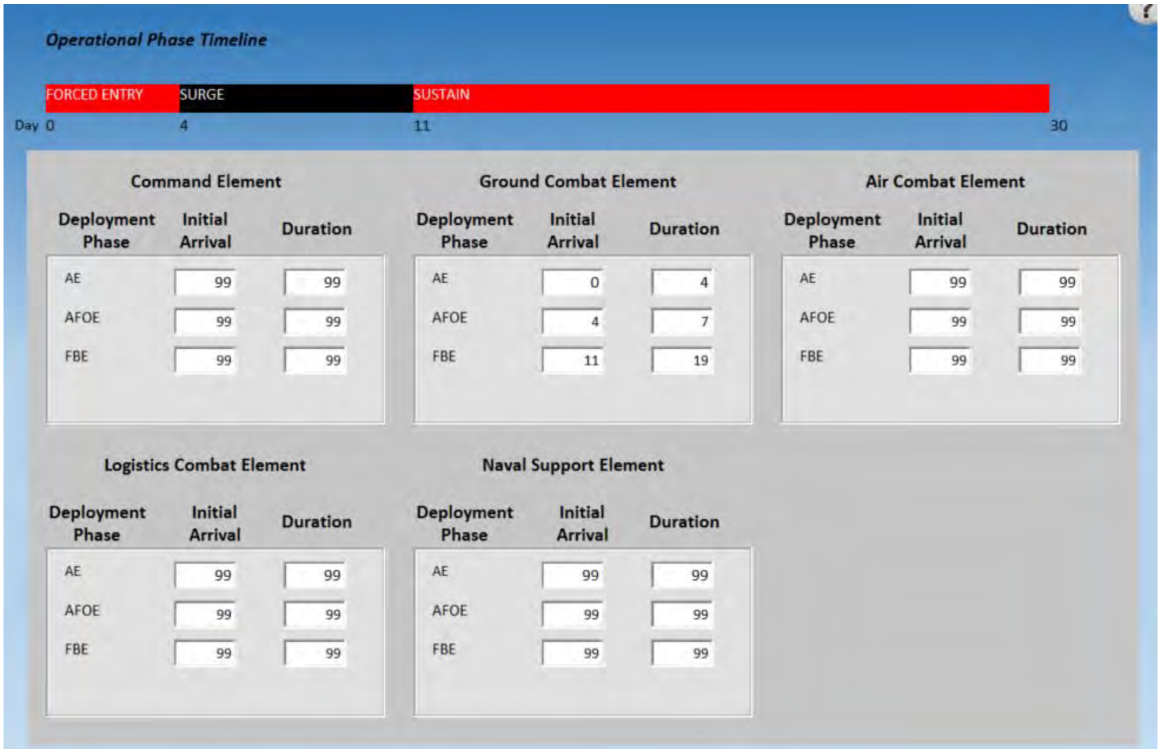
If operating forces are to use tools like MPEM to model and forecast their energy usage, they must be provided with a comprehensive understanding of how the various MPEM inputs affect fuel demand in an operational scenario.

Such an approach may help to improve the precision with which future studies model low level fuel consumption. Otherwise, the generalized data provided by many planning factors sources may mislead planners into the formulation of misguided policies. To this end, the following describes a systematic manipulation of MPEM inputs that aims to yield insights that may work toward extension of the MAGTF's operational reach.

1. Phasing

As depicted by Figure 6, this study is based on a hypothetical amphibious operation in which the GCE is brought ashore in three deployment phases which coincide with three operational phases. The forced entry phase lasts four days and involves the landing of the AE. The surge phase lasts seven days and involves the introduction of the AFOE while the AE continues to operate ashore. Finally, the sustain phase lasts 19 days and deploys the FBE while the AE and AFOE continue to operate. This approach represents the reality that the MEB will require different capabilities over time to match the range of military operations that it is likely to conduct during a given amphibious landing. In total, this scenario matches the advertised 30-day self-sustainment window of the MEB and deploys all GCE units. As discussed, the "99" values seen in Figure 6 indicate that the other combat elements will not be deployed during any operational phase.

Figure 6. Operational Phase Timeline



2. Force Mixes

Some of the most critical decisions that must be made by the GCE staff involve the assignment of units to deployment phases. The staff must ensure that the force ashore is sufficiently capable of meeting the requirements set forth by the operational plan for each day. To represent the wide spectrum of possible deployment schedules, five force mixes were established for this study (Table 2). These force mixes were constructed to represent degrees of combat power arriving at different times. The following descriptions are meant to provide insight into their composition, but a full assignment table can be references in Appendix A.

Table 2. Force Mix Composition

Force Mix	AE	AFOE	FBE
1	Full GCE	---	---
2	3/3 sub-units	H&S units*	---
3	2/3 sub-units	1/3 sub-units	H&S units*
4	1/3 sub-units	2/3 sub-units	H&S units*
5	1/3 sub-units	1/3 sub-units	1/3 sub-units H&S units*

*Only H&S units belonging to a battalion or larger were moved independently of their parent unit. Below the battalion level, HQ elements were phased in such a manner that kept the commander with the majority of his forces.

3. Utilization Rate

Quantified by number of operating hours per day, utilization rate represents a component of tempo. Working from the baseline values provided in the 2024 MEB Baseline constructed by Group W, four categories were built for this study to represent a spectrum of utilization rates. The values for these categories were generated by taking 75 percent, 90 percent, 110 percent, and 125 percent of the baseline hours per day for each equipment type. For some equipment types with high baseline utilization rates, it was necessary to cap the values at 24 hours per day. To reflect the differences in utilization rates that will exist between operational phases, variations were made that rose the utilization rate during surge and lowered it during sustain. Table 3 is a depiction of the variation in utilization rate as a percentage of the baseline values for each operational phase.

Table 3. Utilization Rate Distinction

Phase	Low	Med Low	Baseline	Med High	High
Forced Entry	75%	90%	---	110%	125%
Surge	80%	95%	---	115%	130%
Sustain	70%	85%	---	105%	120%

4. Operating Mode

Also representing a component of tempo, operating mode data refers to the percentage of total operating time that the equipment runs in a low operating mode. According to the 2024 MEB Baseline, 94 equipment types have a low operating mode. Obviously, these values could only be altered for those equipment types, with the other equipment consuming energy at a constant rate per hour. Similar to the approach taken toward utilization rate, four categories were established in order to represent a spectrum of operating mode variation. The values for these categories were generated by taking 75 percent, 87.5 percent, 112.5 percent, and 125 percent of the given baseline. For each of the 94 applicable types, the baseline value was set to represent that the equipment spent 76 percent of its operating hours a low operating mode. The values applied to these equipment types are shown in Table 4.

Table 4. Operating Mode Distinction

Operating Mode	**Low**	**Med Low**	**Baseline**	**Med High**	**High**
% of Baseline	75%	87.5%	---	112.5%	125%
% of Time in Low Op Mode	57%	66.5%	76%	85.5%	95%

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V. DATA ANALYSIS

A. SAMPLING

To understand the effects of the GCE's operational behavior, a data set was systematically collected to create a fuel consumption response surface. This data provided a tie between the way units use their equipment and the amount of fuel consumed. It also ties the force's landing plan to fuel consumption. As detailed in the methodology discussion, the data set was generated by running many iterations of MPEM through the same operational context. More specifically, five force mixes, four utilization rates, and four operating mode profiles were combined to form 80 models of the 30-day operation. Through the establishment of this spectrum of operational behaviors and force mixes, the sample of fuel consumption responses is robust enough to be fit to a linear approximation model. These combinations and the resulting responses are given in Figure 7. Collectively, the figure depicts the 80 data point response surface and serves as visualization for its systematic collection. Model names were assigned using the nomenclature convention of "Force Mix #_Utilization Rate #_Operating Mode #."

Figure 7. Systematic Sampling Plan

	FORCE MIX					
	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	
High UR (1)	1_1_1	2_1_1	3_1_1	4_1_1	5_1_1	High OM (1)
	1_1_2	2_1_2	3_1_2	4_1_2	5_1_2	Med High OM (2)
	1_1_3	2_1_3	3_1_3	4_1_3	5_1_3	Med Low OM (3)
	1_1_4	2_1_4	3_1_4	4_1_4	5_1_4	Low OM (4)
Med High UR (2)	1_2_1	2_2_1	3_2_1	4_2_1	5_2_1	High OM (1)
	1_2_2	2_2_2	3_2_2	4_2_2	5_2_2	Med High OM (2)
	1_2_3	2_2_3	3_2_3	4_2_3	5_2_3	Med Low OM (3)
	1_2_4	2_2_4	3_2_4	4_2_4	5_2_4	Low OM (4)
Med Low UR (3)	1_3_1	2_3_1	3_3_1	4_3_1	5_3_1	High OM (1)
	1_3_2	2_3_2	3_3_2	4_3_2	5_3_2	Med High OM (2)
	1_3_3	2_3_3	3_3_3	4_3_3	5_3_3	Med Low OM (3)
	1_3_4	2_3_4	3_3_4	4_3_4	5_3_4	Low OM (4)
Low UR (4)	1_4_1	2_4_1	3_4_1	4_4_1	5_4_1	High OM (1)
	1_4_2	2_4_2	3_4_2	4_4_2	5_4_2	Med High OM (2)
	1_4_3	2_4_3	3_4_3	4_4_3	5_4_3	Med Low OM (3)
	1_4_4	2_4_4	3_4_4	4_4_4	5_4_4	Low OM (4)

Each of these 80 models produces daily fuel usage data for every individual piece of equipment based on the system and study inputs described in the methodology section of this report. The output spreadsheet data can then be sorted and filtered by unit, unit function, equipment type, or simply by day of the operation. The majority of analysis in this study focuses on the 30-day total fuel consumption of the full GCE as well as that of each unit in the order of battle. While the total fuel quantity consumed will undoubtedly and predictably differ between units, significant insight can be gained by analyzing how force mix, utilization rate, and operating mode affect each unit differently. Figure 8 displays the 30-day total and average daily fuel consumption output values (in gallons) for the total GCE organized in a similar fashion to Figure 7.

Figure 8. Fuel Consumption Responses—Total GCE

30 DAY TOTAL (Gal Fuel)

	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	
High UR (1)	1,468,290	1,361,072	1,073,033	978,825	879,863	High OM (1)
	1,297,722	1,204,263	952,159	868,294	779,792	Med High OM (2)
	956,587	890,645	710,410	647,233	579,650	Med Low OM (3)
	786,019	733,836	589,536	536,702	479,579	Low OM (4)
Med High UR (2)	1,292,163	1,197,003	942,566	859,390	772,483	High OM (1)
	1,142,362	1,059,352	836,507	762,461	684,741	Med High OM (2)
	842,758	784,048	624,390	568,605	509,255	Med Low OM (3)
	692,957	646,397	518,331	471,676	421,513	Low OM (4)
Med Low UR (3)	1,053,590	974,963	766,889	698,452	627,627	High OM (1)
	931,545	862,916	680,624	619,698	556,359	Med High OM (2)
	687,454	638,821	508,093	462,190	413,823	Med Low OM (3)
	565,408	526,774	421,827	383,436	342,554	Low OM (4)
Low UR (4)	873,786	807,878	634,971	577,605	518,841	High OM (1)
	772,569	715,041	563,554	512,484	459,931	Med High OM (2)
	570,134	529,368	420,719	382,242	342,112	Med Low OM (3)
	468,917	436,532	349,302	317,121	283,203	Low OM (4)

AVG DAILY REQUIREMENT (Gal Fuel)

	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	
High UR (1)	48,943.01	45,369.05	35,767.76	32,627.50	29,328.78	High OM (1)
	43,257.41	40,142.09	31,738.62	28,943.14	25,993.08	Med High OM (2)
	31,886.22	29,688.16	23,680.34	21,574.42	19,321.67	Med Low OM (3)
	26,200.62	24,461.20	19,651.20	17,890.06	15,985.96	Low OM (4)
Med High UR (2)	43,072.12	39,900.10	31,418.87	28,646.33	25,749.45	High OM (1)
	38,078.73	35,311.72	27,883.57	25,415.38	22,824.69	Med High OM (2)
	28,091.95	26,134.95	20,812.99	18,953.49	16,975.18	Med Low OM (3)
	23,098.56	21,546.56	17,277.69	15,722.54	14,050.42	Low OM (4)
Med Low UR (3)	35,119.68	32,498.76	25,562.98	23,281.74	20,920.89	High OM (1)
	31,051.50	28,763.85	22,687.46	20,656.60	18,545.29	Med High OM (2)
	22,915.13	21,294.04	16,936.42	15,406.32	13,794.09	Med Low OM (3)
	18,846.95	17,559.14	14,060.90	12,781.18	11,418.48	Low OM (4)
Low UR (4)	29,126.20	26,929.25	21,165.69	19,253.48	17,294.70	High OM (1)
	25,752.29	23,834.71	18,785.12	17,082.79	15,331.04	Med High OM (2)
	19,004.47	17,645.61	14,023.98	12,741.40	11,403.74	Med Low OM (3)
	15,630.55	14,551.06	11,643.41	10,570.71	9,440.08	Low OM (4)

The raw data presented in Figure 8 provides a broad summary of the many MPEM iterations that were conducted. Each of these data points could be dissected into its parts to show fuel consumption of each individual unit. The same could be done to separate the data by day of the operation. The detailed nature of MPEM's output makes possible a variety of analytical approaches. Graphical visualization of the summary data in Figure 8 is useful in revealing key trends which validate intuitive understanding about the influence of force mix, utilization rate and operating mode.

As detailed by Table 2, the force mixes will produce different responses because they involve phasing the landing units over an increasingly greater time period. Force Mix 1 involves landing the entire GCE in the AE and therefore, with all else held constant, should result in greater consumption than the other mixes. Force Mix 5, on the other hand, spreads the landing across all echelons and thereby should result in lesser consumption. These assumptions are verified by Figure 9. The blue ovals in the figure encircle the responses that correspond to the force mixes on the x-axis. The y-axes show total GCE fuel consumption in gallons. Force Mix 5 is used as the base case and thus is not included in the visualization. As expected, one can see a downward trend of fuel consumption as the force mixes increase. This validates expectations about the relationship between the phasing of units ashore and their fuel consumption over the course of the 30-day operation.

The variation of utilization rate in the sample was summarized by Table 3. Intuitively, it stands to reason that the longer a piece of equipment is used in a given day the more fuel it will consume. These values were assigned as a percentage of the baseline usage values. The assumption that utilization and fuel consumption are positively correlated is validated by Figures 9 and 10. In the figures, the red boxes enclose all 80 data points. From the shape of the red boxes, one can see the positive trends. The data is displayed in three dimensions by Figure 10; fuel consumption, utilization rate, and operating mode.

The systematic alteration of the percentage of time equipment spends in low operating mode is shown by Table 4. As a piece of equipment spends a greater percentage of its time in low operating mode, it should decrease the rate at which it consumes fuel. Therefore, the percentage of time in low mode and fuel consumption should be negatively correlated. This intuition is verified by the green boxes in Figures 9 and 10 by showing a downward trend in response values as the percentage of time in low mode increases.

Figure 9. Total GCE Scatterplot Matrix

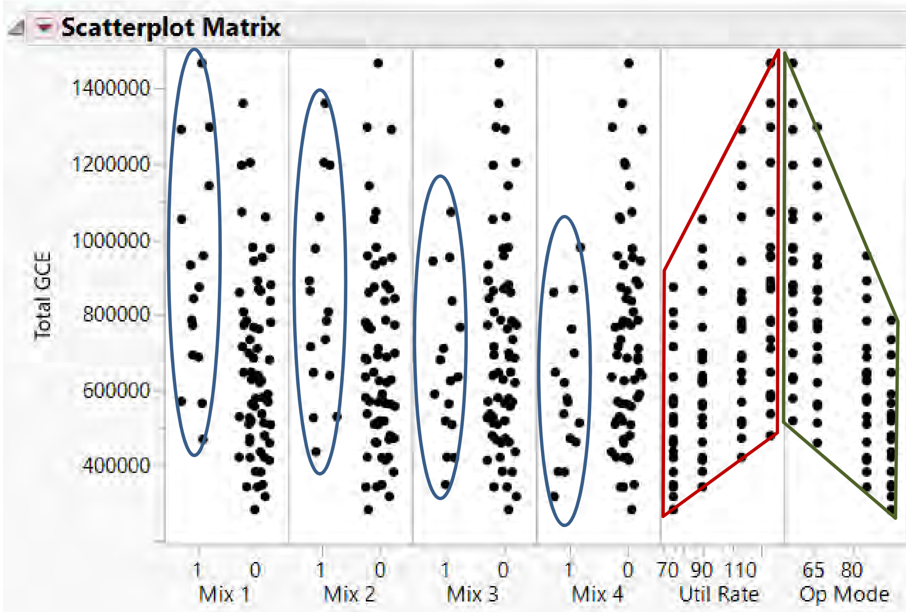
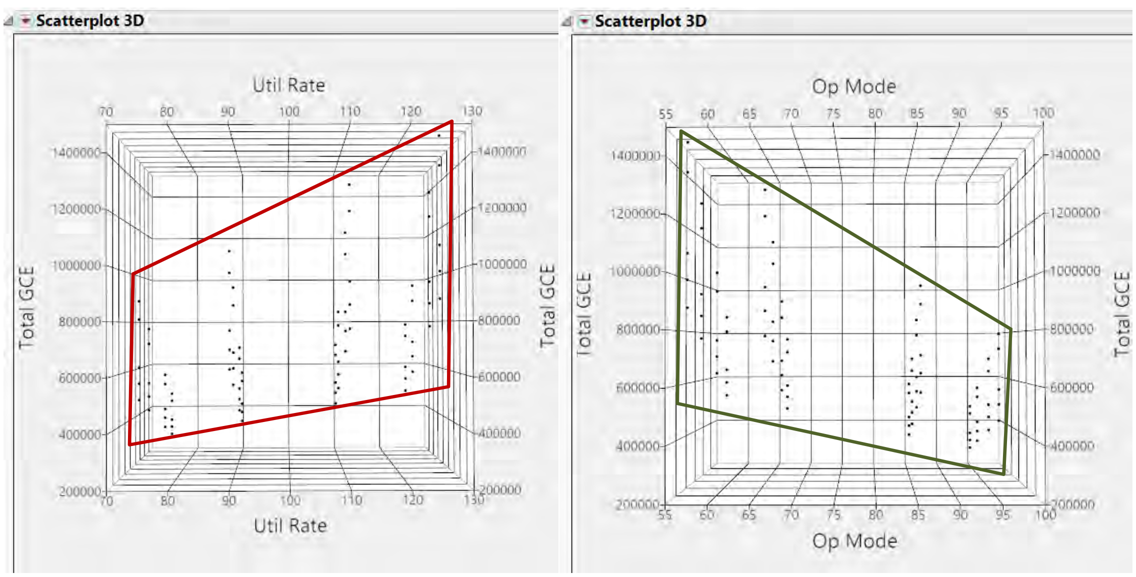


Figure 10. Total GCE Three Dimensional Scatterplots



B. REGRESSION MODELS

To examine the trends displayed by the MPEM outputs in greater detail, an ordinary least squares regression approach was used to model the relationships. Fitting a linear approximation to the sample data allows for quantification of the relationships between operational behavior and fuel consumption. The purpose of this approach is not to provide a means to predict the fuel consumption of realistic MEB operations, but rather to provide a means to understand effect magnitudes across units.

For this approach, 30-day total fuel consumption values are treated as the dependent variables. To gain additional insight, sufficient models were constructed to treat each functional unit (infantry, artillery, tanks, etc.) as a dependent variable in addition to the total GCE values. This approach permits the analyst to quantify the impact that each variable has on fuel consumption in order to identify which functional units display behavior that differs from that of the GCE as a whole. The presence of “misbehavior,” or trends that significantly deviate from those shown by the system as a whole, may indicate a situation which deserves unique consideration on behalf of MEB decision makers and logistics planners.

The value of the linear approximation model approach is dependent on the quality and fidelity of the regression’s coefficients. To arrive at a valuable regression model, therefore, multiple regressions were conducted and their characteristics were compared. The proposed alternatives involved the addition or subtraction of interaction and polynomial independent variable transformations.

Due to the deterministic nature of the MPEM data sample, many traditional significance and goodness of fit metrics are not necessarily applicable in this case. Instead, only the R Square and the sum of the absolute value of residuals metrics were compared for each regression model. A high R Square value is desirable because it indicates that the regression responses are accounting for nearly all of the variation found in the sample data. A low sum of the absolute value of residuals is desirable because it indicates that the regression is producing predictions that closely match the sample data. The comparison of these metrics would thereby favor a model that yielded the closest approximations to the Total GCE data collected in the MPEM data sample.

Comparison between the models are summarized by Table 5. Ultimately, the model that performed best was the one which included main effects and the interaction terms based on a high R Square value (>.99) and a low sum of the absolute value of residuals. The addition of polynomial terms had very little impact on the model's fitness and thus these terms were excluded. The analysis that follows in this study, therefore, is based off the main effects plus interaction terms model. A more detailed summary and comparison of the characteristics of the four regression models can be found in Appendix C.

Table 5. Regression Model Comparison

	Main Effects	ME+Interactions	ME+Polynomials	ME+Int+Poly
R Square	0.956849	0.999364	0.956853	0.999368
Sum of Absolute Residuals	3,374,495	429,825	3,371,332	429,825

A summary of the regression coefficients of the total GCE (left) as well as the largest two consuming units, Tank Battalion (middle) and Amphibious Assault Battalion (right) are presented in Figure 11. The coefficients listed provide a means by which one can compare the relative effect magnitude of force mix, utilization rate, and operating mode. The force mix variables are binary in nature, and only one of the force mix variables may be activated for a given iteration (or none to represent the base case of force mix 5). The utilization rate and operating mode variables, however, are continuous in nature. In the MPEM sample data, utilization rate values fall between 75 and 125 and represent a percentage of baseline usage applied to the forced entry phase (see Table 3). The operating mode values present in the sample data fall between 57 and 95 and represent a percentage of time that equipment is employed in low operating mode (see Table 4). The coefficients for these two variables are relatively low, as compared to those of force mixes, because the variables themselves will assume larger continuous values. The coefficients, and their relative magnitudes across the GCE's sub-units, form the foundation for further analysis and operational insight.

Figure 11. Regression Coefficients

Main Effects + Interaction Terms OLS Regression Summary			
	Total GCE	**Tank Bn**	**AA Bn**
Mean	708,272.8	183,737.0	223,446.6
	Coefficient	*Coefficient*	*Coefficient*
Intercept	1,128,852.6	430,193.9	22,235.6
Mix 1	179,716.7	39,064.0	44,652.1
Mix 2	147,424.5	34,285.2	39,809.4
Mix 3	60,674.5	18,782.9	23,367.4
Mix 4	31,096.5	10,642.7	12,438.8
Utilization Rate	9,737.1	2,503.5	3,015.3
Operation Mode	-15,038.7	-5,725.6	-370.5
Mix 1*UR	1,772.1	389.7	445.1
Mix 1*OM	-2,968.9	-902.6	-117.7
Mix 2*UR	1,466.5	343.3	398.1
Mix 2*OM	-2,386.2	-795.1	-83.5
Mix 3*UR	604.5	187.7	233.2
Mix 3*OM	-876.6	-441.6	-6.1
Mix 4*UR	317.0	108.5	126.8
Mix 4*OM	-438.7	-250.5	-0.1
UR*OM	-113.4	-44.1	-2.5

VI. RECOMMENDATIONS AND CONCLUSIONS

A. OVERVIEW

An understanding of how the fuel demand of the GCE and its subcomponents are influenced by operational decisions and policies offers an opportunity to ease the burden on the critically constrained petroleum logistics network. This study's systematic variation of factors in MPEM created a data set which represents a spectrum of outcomes based on possible operational decisions. The ordinary least squares regression approach provides quantifiable insight regarding how the various policies affect fuel demand over a 30-day period. In the interest of providing valuable operational insight and recommendations, further organization and interpretation of the regression data will follow.

B. OPERATIONAL INSIGHT

1. Behavior of the GCE Units

To gauge the behavior of each functional unit relative to that of the total GCE, the coefficient estimates are divided by the estimate of means. This metric is indicative of the degree to which a marginal change in that factor affects the predicted fuel consumption value. Summarized by Figure 12, this approach and quantifies deviation of the values from the baseline total GCE values. This provides insight into which functional unit(s) "misbehave" relative to the larger system.

Figure 12. Coefficient/Estimate of Means Measures

Coefficient/Est of Means

	UR	UR Dev	OM	OM Dev		Total Dev
Total GCE	1.47%		-2.27%		Total GCE	
AA Bn	1.36%	-0.11%	-0.17%	-2.10%	AA Bn	2.22%
Arty Bn(+)	1.35%	-0.12%	-3.01%	0.74%	Arty Bn(+)	0.86%
CEB	2.03%	0.56%	-3.93%	1.66%	CEB	2.22%
Div HQ Det	2.59%	1.12%	-5.29%	3.02%	Div HQ Det	4.14%
Inf Regt	1.76%	0.29%	-3.62%	1.35%	Inf Regt	1.64%
LAR Bn	1.65%	0.18%	-3.64%	1.37%	LAR Bn	1.55%
Recon Co	1.16%	-0.31%	-2.61%	0.34%	Recon Co	0.65%
Tank Bn	1.39%	-0.08%	-3.18%	0.91%	Tank Bn	0.99%

As indicated by the total deviation values above, the Division HQ Detachment shows the largest deviation from the system baseline followed by the Amphibious Assault Battalion and Combat Engineer Battalion. This means that marginal changes in utilization rate and operation mode values result in a relatively large impact on these units fuel consumption. In other words, the greater the total deviation value in Figure 12, the greater the elasticity of that unit with respect to MPEM input values. This would seem to suggest that a change in Division HQ, Amphibious Assault Battalion, or Combat Engineer Battalion's utilization rate or operating mode policies would have the greatest impact on total fuel demand. This approach ignores, however, the total fuel quantity used by each respective unit. For example, a change in the Division HQ Detachment's behavior will do little to impact the Total GCE fuel consumption because that unit represents only 2 percent of the GCE demand. A policy that influences the behavior of the Amphibious Assault Battalion, on the other hand, would impact the consumer of 34 percent of the GCE demand.

2. Opportunities for Impact

A policy that affects utilization rate or operating mode represents an opportunity to decrease the quantity of fuel that must be moved to support forces operating ashore. Figures 13 and 14 are graphical representations of where these opportunities present themselves. The graph plots coefficient and total fuel demand in order to identify which units could significantly impact total fuel consumption if behavior were to change.

In Figure 13, the top right quadrant represents where the utilization rate coefficient is high and the unit's 30-day fuel consumption is high. Units that occupy this quadrant, therefore, represent the greatest opportunities to reduce the amount of fuel that needs to be moved ashore. Unsurprisingly, the Amphibious Assault Battalion and Tank Battalion are clearly separated from the units in this respect.

In Figure 14, the top left quadrant represents where the operating mode coefficient is a large negative number and the unit's 30-day fuel consumption is high. Therefore, instituting a policy that increases the amount of time that unit's equipment operates in low mode would have the greatest impact on total fuel consumption when applied to units that occupy the top left quadrant. Once again, the Tank Battalion represents the greatest opportunity to have such an effect. Counterintuitively, the Amphibious Assault Battalion appears in the top right quadrant of this graph which means that while total fuel consumption is high, the operating mode coefficient is a small negative number. This is an artifact of the model and can be easily traced to the MPEM equipment profiles which contain data for the M1A1 tanks to operate in low mode, but not for the AAVs. Assuming that this is an accurate representation of the equipment capabilities, a policy that encouraged increased use of the low operating mode would best be applied to the Tank and Artillery Battalions. For example, positioning tanks and artillery in static firebases would permit them to increase the amount of time their equipment can operate in low mode. Meanwhile, patrolling requirements which require prolonged maneuver could be tasked to AAVs, Infantry, and LAR since they represent a lesser opportunity to impact the overall consumption of the GCE.

Figure 13. Utilization Rate: Coefficient versus Demand Visualization

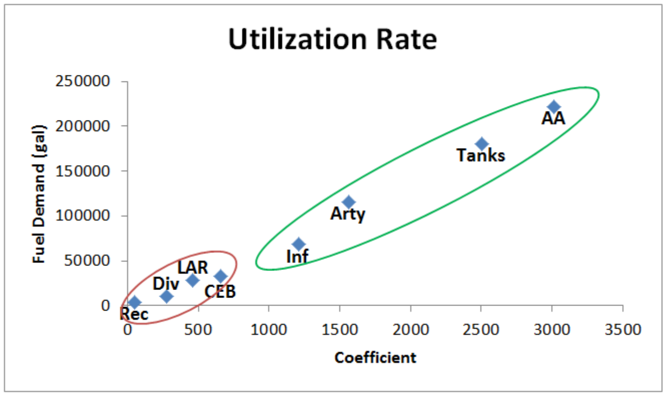
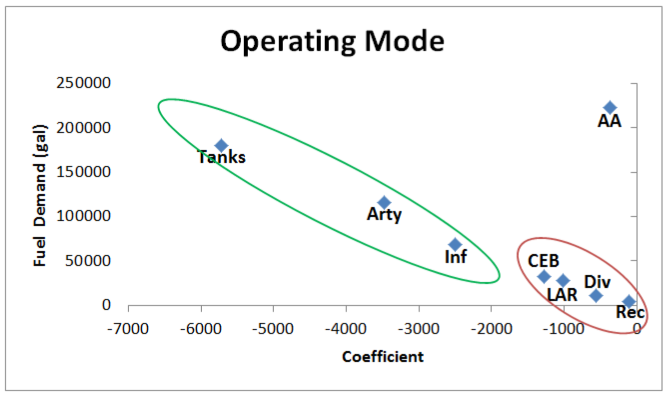


Figure 14. Operating Mode: Coefficient versus Demand Visualization



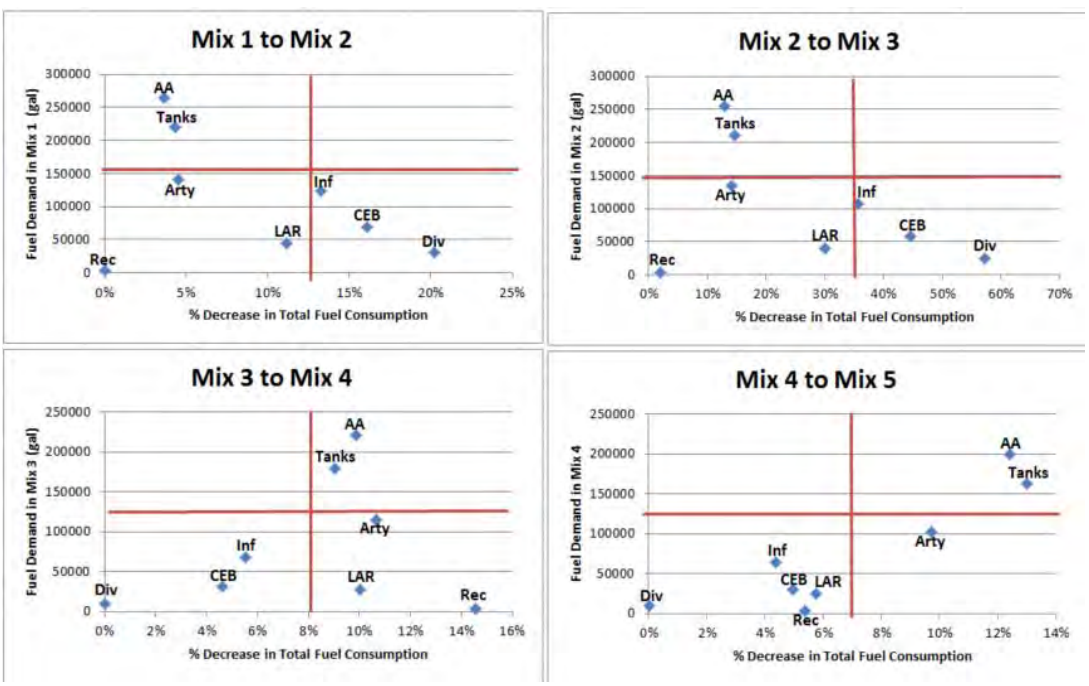
3. Force Mix Comparison

There are also insights to be gained through analysis of the force mix effects. This helps to understand how a change in deployment and movement ashore timing, like the one developed in this study, effects the total fuel demand over a 30-day period. The resulting quantifiable differences between force mixes, however, are the direct result of the decisions described in the experimental design section and Appendix A. Studying the differences between force mixes is valuable as it works to identify trends, support assumptions, and provide an example for future comparison. Identifying the percentage change between Force Mixes for each unit creates a valuable metric for comparing the effects of prolonging the deployment schedules of each unit. Using this approach, one could conclude whether a greater impact is achieved by prolonging the landing schedule of the Tank or Artillery Battalion relative to its total fuel consumption. This would also provide insight about the marginal added benefit to be gained from shifting to successively longer timelines. The percentages of fuel consumption decrease that results from moving between force mixes is shown by Table 6 and Figure 15.

Table 6. Effect of Force Mix Changes on Demand

	Mix 1 to 2	Mix 2 to 3	Mix 3 to 4	Mix 4 to 5
Total GCE	7%	21%	9%	10%
AA Bn	4%	13%	10%	12%
Arty Bn(+)	5%	14%	11%	10%
CEB	16%	45%	5%	5%
Div HQ Det	20%	57%	0%	0%
Inf Regt	13%	36%	6%	4%
LAR Bn	11%	30%	10%	6%
Recon Co	0%	2%	15%	5%
Tank Bn	4%	15%	9%	13%

Figure 15. Force Mix Changes versus Demand Visualization



As shown in Figure 15, the differences between each force mix are a function of when H&S and/or elements of combat power are moved ashore and thus how long they operate and demand fuel. Force Mix 1 is very robust early in the operational timeline, and calls for the deployment of the entire GCE in the AE. Force Mix 2 shifts the deployment of all H&S elements at the battalion level or higher to the AFOE. Depicted in the upper left corner of Figure 15, therefore, is the percentage decrease in consumption that is caused by delaying the deployment of H&S elements by roughly four days. This graphic has indicated that, proportionally, the Combat Engineer Battalion, and Infantry Regiment are affected more by such a change. In other words, relative to the rest of the GCE, these two units have a greater percentage of their fuel demand being generated by H&S assets.

As shown in Appendix A, the Division HQ Detachment is treated as a purely H&S element and thus there is little value in comparing it to the rest of the GCE. Conversely, since the Reconnaissance Company is below the battalion level, its HQ Platoon is moved only when it allows the commander to remain with the majority of his company. This explains the unique, seemingly polar, behavior of these two units.

The Tank, Amphibious Assault, and Artillery Battalions behave similar to each other in that a greater portion of their fuel demand is generated by the line companies or firing batteries rather than their H&S counterparts. The greatest decrease in fuel demand for these units comes when these sub-units are moved from the AE to the AFOE or FBE. The fuel consumption of the Light Armored Reconnaissance H&S element is approximately the same as that of its line companies.

4. Ship to Shore Capacity Implications

Using the data and assumptions detailed by the MAGTF Lift & Distribution Study, it is possible to ascertain the feasibility of supplying the GCE with fuel using only the ship to shore connectors available to the MEB. A summary of this data, assumptions, and subsequent conversion calculations can be found in Appendix D. As a result of the experimental design of this study, a wide spectrum of MPEM output data (30-day fuel consumption) was collected based on the systematic variation of inputs. Analysis of the feasibility of this concept reveals the following general findings.

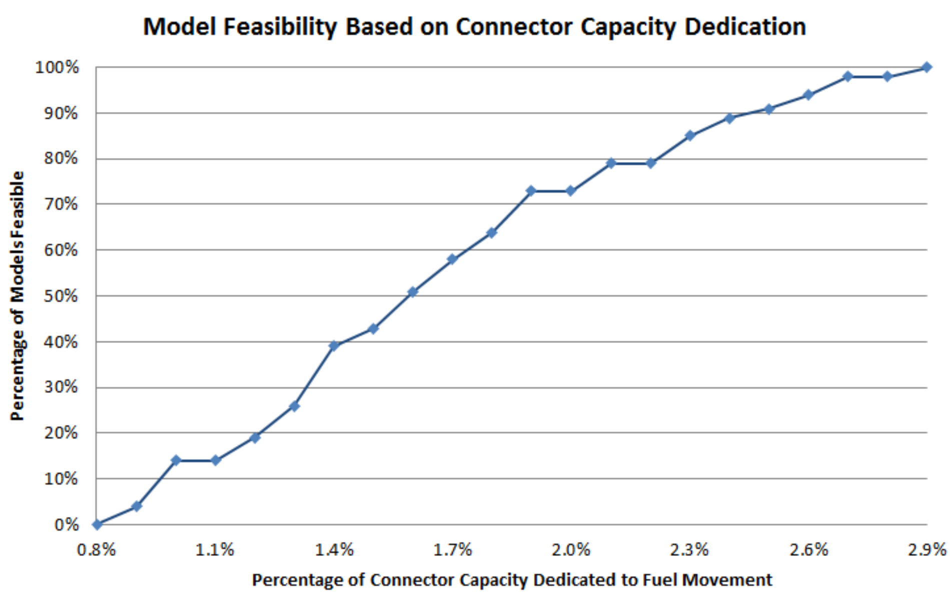
Considering the average daily fuel consumption for each model over the 30-day period and the daily connector throughput capacity makes it possible to arrive at the percentage of total capacity that must be dedicated solely to the movement of fuel if that model's demand is to be met. Such analysis finds that in order to satisfy the model with the greatest average daily demand, that in which Force Mix 1 and high UR/OM levels are utilized, 2.5 percent of total connector throughput capacity must be dedicated to fuel movement. The model with the least daily demand, that in which Force Mix 5 and low UR/OM levels are utilized, requires that 0.5 percent of connector capacity be dedicated to fuel movement. The average amount of throughput capacity that must be devoted to fuel across all models is 1.2 percent.

A different approach is to consider the number of supportable days given a maximum percentage of capacity that can be devoted to fuel. This yields different results than the average daily consumption method as it considers the MPEM output data for each individual day. At the heart of this approach is the principle of minimizing inventories, and the accompanying logistical footprint ashore. Instead it represents a "just in time" approach in which only the amount of fuel needed for the following days operations are delivered. Appendix E shows several tables that reveal the feasibility in number of days for each model given a certain percentage capacity dedication. Those results are summarized by Table 7 and Figure 16.

Table 7. Feasibility of Ship to Shore Fuel Resupply

Percent of Connector Capacity Dedicated to Fuel Movement	Percent of Models that are Feasible for Entire 30-day Operation
0.8%	0%
1.5%	43%
2.0%	73%
2.5%	91%
2.9%	100%

Figure 16. Model Feasibility Graph



Though these numbers may seem low, direct competition with other classes of supply for space aboard connectors may stress the over the shore logistics network considerably. Whether the existence of fuel inventories ashore is permitted or not, this data provides an appreciation for what could be a problematic connector throughput capacity constraint if the system is not managed appropriately. Additionally, it is important to note that these values are based on solely supporting the GCE with their organic logistics assets. In this scenario, all ACE, LCE, and CE units are receiving their fuel directly from the seabase and thus are not competing for connector capacity.

C. RECOMMENDATIONS FOR FUTURE RESEARCH

While this study resulted in numerous important findings, its limitations in scope and data availability call for additional study and continued research to address the research questions comprehensively. The following list is composed of recommended focus areas for future research efforts.

1) The availability of various combat simulation and modeling techniques presents an opportunity to expand upon the force mix approach of this study. The use of MASS (United States Marine Corps, 2015) to develop a comprehensive logistics plan followed by the use of a tool like MANA (Parker Jr., 2015) could yield insight regarding the efficiency, feasibility, and effectiveness of landing plans, force composition and logistics networks in various combat scenarios.

2) This study attempted to keep assumptions regarding maintenance and fuel consumption rates consistent with the MPEM Baseline values. The effects of utilization rate and operating mode were revealed through systematic variation of each model. In a realistic operational scenario, each of these rates will vary. Should adequate data become available regarding variation amongst equipment in specific operational scenarios, it could be applied to a study that focused on accurately modeling total fuel consumption. Such an effort could work toward validating the tools and approach in order to create buy in amongst the logistical planners of the operating forces.

3) Any attempt at the facilitation of "just in time" logistics will rely heavily on the uninterrupted flow of timely and accurate information. Without the reliable transmission of fuel levels, maintenance issues, local supply inventories, etc., planners will be forced to position safety stock resources ashore and thus incur additional operational risk. Research should be dedicated to not only the

development of “common logistics operational picture” software, but also its integration with an optimized inventory management and control system.

D. SUMMARY

Through the use and application of MPEM, this study primarily aimed to improve the accuracy with which fuel usage is forecasted and provide insight that may help logistics planners to better understand tradeoffs between operational and foundational risk. To that end, the main effort of this study revealed the following significant insights:

1) The implementation of a policy that seeks to lower utilization rate will have the greatest effect on total fuel consumption quantities when applied to Amphibious Assault, Tanks, and Artillery Battalions.

2) The implementation of a policy that seeks to raise the use of low operating modes will have the greatest effect on total fuel consumption quantities when applied to Tank Battalions, Artillery Battalions, and Infantry Regiments.

3) The delayed deployment of H&S elements at the battalion level and above has the greatest proportional effect on the fuel consumption of the Combat Engineer Battalion and Infantry Regiment. The delayed deployment of other sub-units (line companies and firing batteries) has the greatest proportional effect on the fuel consumption of the Tanks, Amphibious Assault, and Artillery Battalions.

4) Any of the policy implementations or behavioral changes listed above would work to reduce a stressed ship to shore logistics system which may be forced to rely on low capacity connectors. This system could require the dedication of up to 2.9 percent of the MEB connectors’ throughput capacity by weight solely to fuel transportation in order to meet the GCE’s daily demand throughout the advertised 30-day window of self-sustainability. Considering the additional requirements imposed by various other classes of supply which must also be moved via these same connectors, this system must be well managed in

order to avoid shortfalls. That said, the capacity and throughput of MEB connectors appears sufficient to support GCE operations ashore. The addition of LCE, ACE, and CE units to the fuel demand ashore would change this conclusion.

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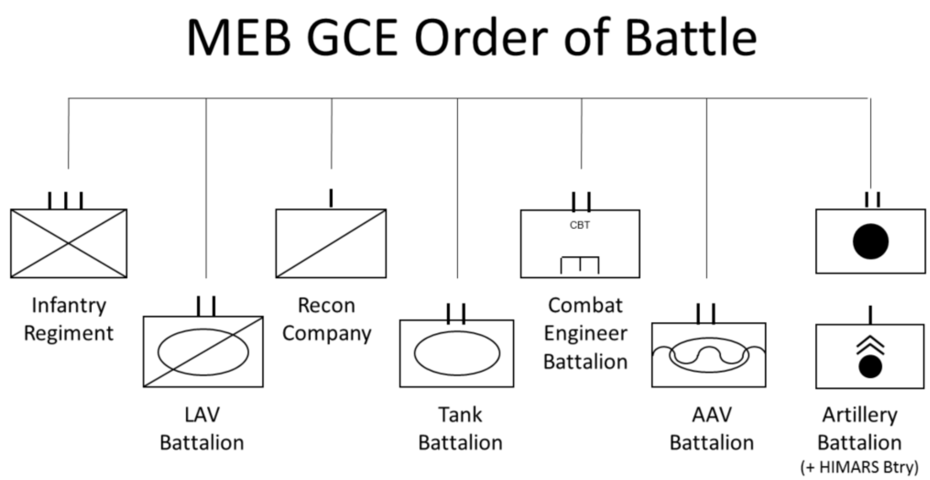
APPENDIX A. TABLE OF ORGANIZATION AND DEPLOYMENT PHASE DATA



Assumption: Units deploy with 100% of their assets. Binary system used.

Unit ID	Combat Ele	Mix 1 AE	Mix 1 AFOE	Mix 1 FOE	Mix 2 AE	Mix 2 AFOE	Mix 2 FOE	Mix 3 AE	Mix 3 AFOE	Mix 3 FOE	Mix 4 AE	Mix 4 AFOE	Mix 4 FOE	Mix 5 AE	Mix 5 AFOE	Mix 5 FOE
AA BN CO A 1ST PLT HQ SECT	GCE	1			1			1			1			1		
AA BN CO A 1ST PLT SECT 1	GCE	1			1			1			1			1		
AA BN CO A 1ST PLT SECT 2	GCE	1			1			1			1			1		
AA BN CO A 1ST PLT SECT 3	GCE	1			1			1			1			1		
AA BN CO A 2ND PLT HQ SECT	GCE	1			1			1				1			1	
AA BN CO A 2ND PLT SECT 1	GCE	1			1			1				1			1	
AA BN CO A 2ND PLT SECT 2	GCE	1			1			1				1			1	
AA BN CO A 2ND PLT SECT 3	GCE	1			1			1				1			1	
AA BN CO A 3RD PLT HQ SECT	GCE	1			1				1			1				1
AA BN CO A 3RD PLT SECT 1	GCE	1			1				1			1				1
AA BN CO A 3RD PLT SECT 2	GCE	1			1				1			1				1
AA BN CO A 3RD PLT SECT 3	GCE	1			1				1			1				1
AA BN CO A HQ PLT AMTRAC SECT	GCE	1			1			1				1			1	
AA BN CO A HQ PLT C&C SECT	GCE	1			1			1				1			1	
AA BN CO A HQ PLT COMM SECT	GCE	1			1			1				1			1	
AA BN CO A HQ PLT HQ SECT	GCE	1			1			1				1			1	
AA BN CO A HQ PLT MAINT SECT	GCE	1			1			1				1			1	
AA BN CO B 1ST PLT HQ SECT	GCE	1			1			1			1			1		
AA BN CO B 1ST PLT SECT 1	GCE	1			1			1			1			1		
AA BN CO B 1ST PLT SECT 2	GCE	1			1			1			1			1		
AA BN CO B 1ST PLT SECT 3	GCE	1			1			1			1			1		
AA BN CO B 2ND PLT HQ SECT	GCE	1			1			1				1			1	
AA BN CO B 2ND PLT SECT 1	GCE	1			1			1				1			1	
AA BN CO B 2ND PLT SECT 2	GCE	1			1			1				1			1	
AA BN CO B 2ND PLT SECT 3	GCE	1			1			1				1			1	
AA BN CO B 3RD PLT HQ SECT	GCE	1			1				1			1				1
AA BN CO B 3RD PLT SECT 1	GCE	1			1				1			1				1
AA BN CO B 3RD PLT SECT 2	GCE	1			1				1			1				1
AA BN CO B 3RD PLT SECT 3	GCE	1			1				1			1				1
AA BN CO B HQ PLT AMTRAC SECT	GCE	1			1			1				1			1	
AA BN CO B HQ PLT C&C SECT	GCE	1			1			1				1			1	
AA BN CO B HQ PLT COMM SECT	GCE	1			1			1				1			1	
AA BN CO B HQ PLT HQ SECT	GCE	1			1			1				1			1	
AA BN CO B HQ PLT MAINT SECT	GCE	1			1			1				1			1	
AA BN H&S CO AMTRAC SECT	GCE	1				1				1			1			1
AA BN H&S CO C&C SECT 1	GCE	1				1				1			1			1
AA BN H&S CO C&C SECT 2	GCE	1				1				1			1			1
AA BN H&S CO MAINT SECT	GCE	1				1				1			1			1
AA BN H&S CO MED SECT	GCE	1				1				1			1			1
AA BN H&S CO OPS SECT	GCE	1				1				1			1			1
AA BN H&S CO S2 SECT	GCE	1				1				1			1			1
AA BN H&S CO S4 SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY CIV AFF SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY CMD GRP	GCE	1				1				1			1			1
ARTY BN HQ BTRY COMM PLT DATA SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY COMM PLT HQ SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY COMM PLT RADIO SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY COMM PLT WIRE SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY HQ SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY LIAIS SECT	GCE	1				1				1			1			1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1			Mix 2			Mix 3			Mix 4			Mix 5		
ARTY BN HQ BTRY NGF SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY NGF SECT LIAIS A	GCE	1				1				1			1			1
ARTY BN HQ BTRY NGF SECT LIAIS B	GCE	1				1				1			1			1
ARTY BN HQ BTRY OPS SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY S1 SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY S2 SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY SERVICE PLT CHAP SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY SERVICE PLT DIN FAC SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY SERVICE PLT LOG SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY SERVICE PLT MED SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY SERVICE PLT MT SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY SERVICE PLT SUPP SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY SURVEY SECT	GCE	1				1				1			1			1
ARTY BN HQ BTRY SURVEY SECT PADS SURVI	GCE	1				1				1			1			1
ARTY BN HQ BTRY SURVEY SECT PADS SURVI	GCE	1				1				1			1			1
ARTY BN BTRY A AMMO SECT	GCE	1			1			1			1			1		
ARTY BN BTRY A COMM SECT	GCE	1			1			1			1			1		
ARTY BN BTRY A FIRING PLT BTRY OPS CENT	GCE	1			1			1			1			1		
ARTY BN BTRY A FIRING PLT FDC	GCE	1			1			1			1			1		
ARTY BN BTRY A FIRING PLT SECT 1 TM A	GCE	1			1			1			1			1		
ARTY BN BTRY A FIRING PLT SECT 1 TM B	GCE	1			1			1			1			1		
ARTY BN BTRY A FIRING PLT SECT 1 TM C	GCE	1			1			1			1			1		
ARTY BN BTRY A FIRING PLT SECT 2 TM A	GCE	1			1			1			1			1		
ARTY BN BTRY A FIRING PLT SECT 2 TM B	GCE	1			1			1			1			1		
ARTY BN BTRY A FIRING PLT SECT 2 TM C	GCE	1			1			1			1			1		
ARTY BN BTRY A HQ SECT	GCE	1			1			1			1			1		
ARTY BN BTRY A LIAISON SECT FO TM A	GCE	1			1			1			1			1		
ARTY BN BTRY A LIAISON SECT FO TM B	GCE	1			1			1			1			1		
ARTY BN BTRY A LIAISON SECT FO TM C	GCE	1			1			1			1			1		
ARTY BN BTRY A LIAISON SECT LIAISON TM	GCE	1			1			1			1			1		
ARTY BN BTRY A MAINT SECT	GCE	1			1			1			1			1		
ARTY BN BTRY A MED SECT	GCE	1			1			1			1			1		
ARTY BN BTRY B AMMO SECT	GCE	1			1			1				1			1	
ARTY BN BTRY B COMM SECT	GCE	1			1			1				1			1	
ARTY BN BTRY B FIRING PLT BTRY OPS CENT	GCE	1			1			1				1			1	
ARTY BN BTRY B FIRING PLT FDC	GCE	1			1			1				1			1	
ARTY BN BTRY B FIRING PLT SECT 1 TM A	GCE	1			1			1				1			1	
ARTY BN BTRY B FIRING PLT SECT 1 TM B	GCE	1			1			1				1			1	
ARTY BN BTRY B FIRING PLT SECT 1 TM C	GCE	1			1			1				1			1	
ARTY BN BTRY B FIRING PLT SECT 2 TM A	GCE	1			1			1				1			1	
ARTY BN BTRY B FIRING PLT SECT 2 TM B	GCE	1			1			1				1			1	
ARTY BN BTRY B FIRING PLT SECT 2 TM C	GCE	1			1			1				1			1	
ARTY BN BTRY B HQ SECT	GCE	1			1			1				1			1	
ARTY BN BTRY B LIAISON SECT FO TM A	GCE	1			1			1				1			1	
ARTY BN BTRY B LIAISON SECT FO TM B	GCE	1			1			1				1			1	
ARTY BN BTRY B LIAISON SECT FO TM C	GCE	1			1			1				1			1	
ARTY BN BTRY B LIAISON SECT LIAISON TM	GCE	1			1			1				1			1	
ARTY BN BTRY B MAINT SECT	GCE	1			1			1				1			1	
ARTY BN BTRY B MED SECT	GCE	1			1			1				1			1	
ARTY BN BTRY C AMMO SECT	GCE	1			1				1			1				1
ARTY BN BTRY C COMM SECT	GCE	1			1				1			1				1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1			Mix 2			Mix 3			Mix 4			Mix 5		
ARTY BN BTRY C FIRING PLT BTRY OPS CENT	GCE	1			1				1			1				1
ARTY BN BTRY C FIRING PLT FDC	GCE	1			1				1			1				1
ARTY BN BTRY C FIRING PLT SECT 1 TM A	GCE	1			1				1			1				1
ARTY BN BTRY C FIRING PLT SECT 1 TM B	GCE	1			1				1			1				1
ARTY BN BTRY C FIRING PLT SECT 1 TM C	GCE	1			1				1			1				1
ARTY BN BTRY C FIRING PLT SECT 2 TM A	GCE	1			1				1			1				1
ARTY BN BTRY C FIRING PLT SECT 2 TM B	GCE	1			1				1			1				1
ARTY BN BTRY C FIRING PLT SECT 2 TM C	GCE	1			1				1			1				1
ARTY BN BTRY C HQ SECT	GCE	1			1				1			1				1
ARTY BN BTRY C LIAISON SECT FO TM A	GCE	1			1				1			1				1
ARTY BN BTRY C LIAISON SECT FO TM B	GCE	1			1				1			1				1
ARTY BN BTRY C LIAISON SECT FO TM C	GCE	1			1				1			1				1
ARTY BN BTRY C LIAISON SECT LIAISON TM	GCE	1			1				1			1				1
ARTY BN BTRY C MAINT SECT	GCE	1			1				1			1				1
ARTY BN BTRY C MED SECT	GCE	1			1				1			1				1
ARTY BN REGT DET TGT ACQ PLT MET SECT SI	GCE	1			1			1				1			1	
ARTY BN REGT DET TGT ACQ PLT RADAR TM 1	GCE	1			1			1				1			1	
ARTY BN REGT DET TGT ACQ PLT RADAR TM 2	GCE	1			1			1				1			1	
ARTY BN REGT DET TGT ACQ PLT RADAR TM 3	GCE	1			1			1				1			1	
ARTY BN REGT DET TGT ACQ PLT SENSOR SE(	GCE	1			1			1				1			1	
ARTY BN REGT DET TGT ACQ PLT TGT PROC S	GCE	1			1			1				1			1	
CBT ENGR BN CO A 1ST PLT HQ SQD	GCE	1			1			1			1			1		
CBT ENGR BN CO A 1ST PLT SQD 1	GCE	1			1			1			1			1		
CBT ENGR BN CO A 1ST PLT SQD 2	GCE	1			1			1			1			1		
CBT ENGR BN CO A 1ST PLT SQD 3	GCE	1			1			1			1			1		
CBT ENGR BN CO A 2ND PLT HQ SQD	GCE	1			1			1				1			1	
CBT ENGR BN CO A 2ND PLT SQD 1	GCE	1			1			1				1			1	
CBT ENGR BN CO A 2ND PLT SQD 2	GCE	1			1			1				1			1	
CBT ENGR BN CO A 2ND PLT SQD 3	GCE	1			1			1				1			1	
CBT ENGR BN CO A 3RD PLT HQ SQD	GCE	1			1				1			1				1
CBT ENGR BN CO A 3RD PLT SQD 1	GCE	1			1				1			1				1
CBT ENGR BN CO A 3RD PLT SQD 2	GCE	1			1				1			1				1
CBT ENGR BN CO A 3RD PLT SQD 3	GCE	1			1				1			1				1
CBT ENGR BN CO A HQ PLT	GCE	1			1			1				1			1	
CBT ENGR BN CO B 1ST PLT HQ SQD	GCE	1			1			1			1			1		
CBT ENGR BN CO B 1ST PLT SQD 1	GCE	1			1			1			1			1		
CBT ENGR BN CO B 1ST PLT SQD 2	GCE	1			1			1			1			1		
CBT ENGR BN CO B 1ST PLT SQD 3	GCE	1			1			1			1			1		
CBT ENGR BN CO B 2ND PLT HQ SQD	GCE	1			1			1				1			1	
CBT ENGR BN CO B 2ND PLT SQD 1	GCE	1			1			1				1			1	
CBT ENGR BN CO B 2ND PLT SQD 2	GCE	1			1			1				1			1	
CBT ENGR BN CO B 2ND PLT SQD 3	GCE	1			1			1				1			1	
CBT ENGR BN CO B 3RD PLT HQ SQD	GCE	1			1				1			1				1
CBT ENGR BN CO B 3RD PLT SQD 1	GCE	1			1				1			1				1
CBT ENGR BN CO B 3RD PLT SQD 2	GCE	1			1				1			1				1
CBT ENGR BN CO B 3RD PLT SQD 3	GCE	1			1				1			1				1
CBT ENGR BN CO B HQ PLT	GCE	1			1			1				1			1	
CBT ENGR BN ENG SPT CO HQ SECT COMM SG	GCE	1				1				1			1			1
CBT ENGR BN ENG SPT CO HQ SECT CONST S(	GCE	1				1				1			1			1
CBT ENGR BN ENG SPT CO HQ SECT LOG SQD	GCE	1				1				1			1			1
CBT ENGR BN ENG SPT CO SECT 1	GCE	1				1				1			1			1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1			Mix 2			Mix 3			Mix 4			Mix 5		
CBT ENGR BN ENG SPT CO SECT 2	GCE	1				1				1			1			1
COMM CO DET MUX TM 1	GCE	1				1				1			1			1
COMM CO DET MUX TM 2	GCE	1				1				1			1			1
COMM CO DET SMART-T TM	GCE	1				1				1			1			1
DIV HQ BN DET CHAP SECT	GCE	1				1				1			1			1
DIV HQ BN DET CMBT PHOTO SECT	GCE	1				1				1			1			1
DIV HQ BN DET COMM SECT	GCE	1				1				1			1			1
DIV HQ BN DET DIN FAC SECT	GCE	1				1				1			1			1
DIV HQ BN DET ELEC SECT	GCE	1				1				1			1			1
DIV HQ BN DET INFO OPS SECT	GCE	1				1				1			1			1
DIV HQ BN DET MED SECT	GCE	1				1				1			1			1
DIV HQ BN DET MP SECT	GCE	1				1				1			1			1
DIV HQ BN DET MT SECT	GCE	1				1				1			1			1
DIV HQ BN DET S1 SECT	GCE	1				1				1			1			1
DIV HQ BN DET S4 SECT	GCE	1				1				1			1			1
ARTY BN HIMARS BTRY AMMO SECT	GCE	1			1			1			1			1		
ARTY BN HIMARS BTRY COMM SECT	GCE	1			1			1			1			1		
ARTY BN HIMARS BTRY FIRING PLT 1 HQ SECT	GCE	1			1			1			1			1		
ARTY BN HIMARS BTRY FIRING PLT 1 LIAIS SEC	GCE	1			1			1			1			1		
ARTY BN HIMARS BTRY FIRING PLT 1 OPS SEC'	GCE	1			1			1			1			1		
ARTY BN HIMARS BTRY FIRING PLT 1 RKT SECT	GCE	1			1			1			1			1		
ARTY BN HIMARS BTRY FIRING PLT 1 RKT SECT	GCE	1			1			1				1			1	
ARTY BN HIMARS BTRY FIRING PLT 1 RKT SECT	GCE	1			1				1			1				1
ARTY BN HIMARS BTRY FIRING PLT 2 HQ SECT	GCE	1			1			1			1			1		
ARTY BN HIMARS BTRY FIRING PLT 2 LIAIS SEC	GCE	1			1			1			1			1		
ARTY BN HIMARS BTRY FIRING PLT 2 OPS SEC	GCE	1			1			1			1			1		
ARTY BN HIMARS BTRY FIRING PLT 2 RKT SEC'	GCE	1			1			1			1			1		
ARTY BN HIMARS BTRY FIRING PLT 2 RKT SEC'	GCE	1			1			1				1			1	
ARTY BN HIMARS BTRY FIRING PLT 2 RKT SEC'	GCE	1			1				1			1				1
ARTY BN HIMARS BTRY HQ PLT	GCE	1			1			1				1			1	
ARTY BN HIMARS BTRY OPS SECT	GCE	1			1			1			1			1		
ARTY BN HIMARS BTRY SERV SECT	GCE	1			1			1				1			1	
INF BN 1(SURF) CO A 1ST PLT HQ SQD	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 1ST PLT SQD 1 HQ TM	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 1ST PLT SQD 1 TM 1	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 1ST PLT SQD 1 TM 2	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 1ST PLT SQD 1 TM 3	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 1ST PLT SQD 2 HQ TM	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 1ST PLT SQD 2 TM 1	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 1ST PLT SQD 2 TM 2	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 1ST PLT SQD 2 TM 3	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 1ST PLT SQD 3 HQ TM	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 1ST PLT SQD 3 TM 1	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 1ST PLT SQD 3 TM 2	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 1ST PLT SQD 3 TM 3	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 2ND PLT HQ SQD	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 2ND PLT SQD 1 HQ TM	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 2ND PLT SQD 1 TM 1	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 2ND PLT SQD 1 TM 2	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 2ND PLT SQD 1 TM 3	GCE	1			1			1			1			1		
INF BN 1(SURF) CO A 2ND PLT SQD 2 HQ TM	GCE	1			1			1			1			1		

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
INF BN 1(SURF) CO A 2ND PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 2ND PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 2ND PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 2ND PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 2ND PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 2ND PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 2ND PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 3RD PLT HQ SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 3RD PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 3RD PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 3RD PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 3RD PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 3RD PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 3RD PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 3RD PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 3RD PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 3RD PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 3RD PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 3RD PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO A 3RD PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO A HQ PLT	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT 60MM SECT HC	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT 60MM SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT 60MM SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT 60MM SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT ASLT SECT HC	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT ASLT SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT ASLT SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT ASLT SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT HQ SECT	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT MG SECT HQ S	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO A WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 1ST PLT HQ SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 1ST PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 1ST PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 1ST PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 1ST PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 1ST PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 1ST PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 1ST PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 1ST PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 1ST PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 1ST PLT SQD 3 TM 1	GCE	1	1	1	1	1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
INF BN 1(SURF) CO B 1ST PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 1ST PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 2ND PLT HQ SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 2ND PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 2ND PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 2ND PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 2ND PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 2ND PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 2ND PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 2ND PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 2ND PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 2ND PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 2ND PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 2ND PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 2ND PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 3RD PLT HQ SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 3RD PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 3RD PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 3RD PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 3RD PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 3RD PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 3RD PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 3RD PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 3RD PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 3RD PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 3RD PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 3RD PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO B 3RD PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO B HQ PLT	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT 60MM SECT HC	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT 60MM SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT 60MM SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT 60MM SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT ASLT SECT HC	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT ASLT SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT ASLT SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT ASLT SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT HQ SECT	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT MG SECT HQ S	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO B WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 1ST PLT HQ SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 1ST PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 1ST PLT SQD 1 TM 1	GCE	1	1	1	1	1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
INF BN 1(SURF) CO C 1ST PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 1ST PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 1ST PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 1ST PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 1ST PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 1ST PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 1ST PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 1ST PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 1ST PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 1ST PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 2ND PLT HQ SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 2ND PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 2ND PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 2ND PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 2ND PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 2ND PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 2ND PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 2ND PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 2ND PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 2ND PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 2ND PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 2ND PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 2ND PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 3RD PLT HQ SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 3RD PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 3RD PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 3RD PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 3RD PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 3RD PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 3RD PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 3RD PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 3RD PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 3RD PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 3RD PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 3RD PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 1(SURF) CO C 3RD PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 1(SURF) CO C HQ PLT	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT 60MM SECT HC	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT 60MM SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT 60MM SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT 60MM SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT ASLT SECT HC	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT ASLT SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT ASLT SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT ASLT SECT SC	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT HQ SECT	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT MG SECT HQ S	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT MG SECT SQD	GCE	1	1	1	1	1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
INF BN 1(SURF) CO C WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) CO C WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO BN HQ	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO CHAP SHOP	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO HQ PLT	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO MED SHOP BAS 1	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO MED SHOP BAS 2	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO MED SHOP CO TM A	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO MED SHOP CO TM B	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO MED SHOP CO TM C	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO MED SHOP CO TM W	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S1 SHOP	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S2 SHOP HQ PLT	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S2 SHOP INTEL PLT	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S2 SHOP SNIP PLT	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S3 SHOP DIST OPS SE	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S3 SHOP OPS PLT AIR	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S3 SHOP OPS PLT CBI	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S3 SHOP OPS PLT HQ	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S3 SHOP OPS PLT IO C	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S4 SHOP LOG SECT	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S4 SHOP SERV PLT AF	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S4 SHOP SERV PLT DF	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S4 SHOP SERV PLT HC	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S4 SHOP SERV PLT M1	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S4 SHOP SERV PLT SL	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S4 SHOP SERV PLT TC	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S6 SHOP DATA SECT	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S6 SHOP HQ SECT	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S6 SHOP MAINT SECT	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S6 SHOP MORT SECT L	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S6 SHOP MORT SECT I	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S6 SHOP MORT SECT I	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S6 SHOP MORT SECT I	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S6 SHOP RADIO SECT	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S6 SHOP TACP SECT F	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S6 SHOP TACP SECT F	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S6 SHOP TACP SECT T	GCE	1	1	1	1	1
INF BN 1(SURF) H&S CO S6 SHOP WIRE SECT	GCE	1	1	1	1	1
INF BN 1(SURF) WPNS CO 81MM PLT FDC 1	GCE	1	1	1	1	1
INF BN 1(SURF) WPNS CO 81MM PLT FDC 2	GCE	1	1	1	1	1
INF BN 1(SURF) WPNS CO 81MM PLT HQ SECT	GCE	1	1	1	1	1
INF BN 1(SURF) WPNS CO 81MM PLT SECT 1 HQ	GCE	1	1	1	1	1
INF BN 1(SURF) WPNS CO 81MM PLT SECT 1 SQ	GCE	1	1	1	1	1
INF BN 1(SURF) WPNS CO 81MM PLT SECT 1 SQ	GCE	1	1	1	1	1
INF BN 1(SURF) WPNS CO 81MM PLT SECT 1 SQ	GCE	1	1	1	1	1
INF BN 1(SURF) WPNS CO 81MM PLT SECT 1 SQ	GCE	1	1	1	1	1
INF BN 1(SURF) WPNS CO 81MM PLT SECT 2 HG	GCE	1	1	1	1	1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1			Mix 2			Mix 3			Mix 4			Mix 5		
INF BN 1 (SURF) WPNS CO 81MM PLT SECT 2 SG	GCE	1			1			1				1			1	
INF BN 1 (SURF) WPNS CO 81MM PLT SECT 2 SG	GCE	1			1			1				1			1	
INF BN 1 (SURF) WPNS CO 81MM PLT SECT 2 SG	GCE	1			1			1				1			1	
INF BN 1 (SURF) WPNS CO 81MM PLT SECT 2 SG	GCE	1			1			1				1			1	
INF BN 1 (SURF) WPNS CO AA PLT HQ SECT	GCE	1			1				1			1				1
INF BN 1 (SURF) WPNS CO AA PLT JAV SECT HC	GCE	1			1				1			1				1
INF BN 1 (SURF) WPNS CO AA PLT JAV SECT SC	GCE	1			1				1			1				1
INF BN 1 (SURF) WPNS CO AA PLT JAV SECT SC	GCE	1			1				1			1				1
INF BN 1 (SURF) WPNS CO AA PLT TOW SECT HI	GCE	1			1				1			1				1
INF BN 1 (SURF) WPNS CO AA PLT TOW SECT SI	GCE	1			1				1			1				1
INF BN 1 (SURF) WPNS CO AA PLT TOW SECT SI	GCE	1			1				1			1				1
INF BN 1 (SURF) WPNS CO AA PLT TOW SECT SI	GCE	1			1				1			1				1
INF BN 1 (SURF) WPNS CO AA PLT TOW SECT SI	GCE	1			1				1			1				1
INF BN 1 (SURF) WPNS CO HMG PLT HQ SECT	GCE	1			1			1			1			1		
INF BN 1 (SURF) WPNS CO HMG PLT SECT 1 SQ[	GCE	1			1			1			1			1		
INF BN 1 (SURF) WPNS CO HMG PLT SECT 1 SQ[	GCE	1			1			1			1			1		
INF BN 1 (SURF) WPNS CO HMG PLT SECT 2 SQI	GCE	1			1			1			1			1		
INF BN 1 (SURF) WPNS CO HMG PLT SECT 2 SQI	GCE	1			1			1			1			1		
INF BN 1 (SURF) WPNS CO HMG PLT SECT 3 SQI	GCE	1			1			1			1			1		
INF BN 1 (SURF) WPNS CO HMG PLT SECT 3 SQI	GCE	1			1			1			1			1		
INF BN 1 (SURF) WPNS CO HQ PLT	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO E 1ST PLT HQ SQD	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 1ST PLT SQD 1 HQ TM	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 1ST PLT SQD 1 TM 1	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 1ST PLT SQD 1 TM 2	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 1ST PLT SQD 1 TM 3	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 1ST PLT SQD 2 HQ TM	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 1ST PLT SQD 2 TM 1	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 1ST PLT SQD 2 TM 2	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 1ST PLT SQD 2 TM 3	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 1ST PLT SQD 3 HQ TM	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 1ST PLT SQD 3 TM 1	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 1ST PLT SQD 3 TM 2	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 1ST PLT SQD 3 TM 3	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 2ND PLT HQ SQD	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 2ND PLT SQD 1 HQ TM	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 2ND PLT SQD 1 TM 1	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 2ND PLT SQD 1 TM 2	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 2ND PLT SQD 1 TM 3	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 2ND PLT SQD 2 HQ TM	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 2ND PLT SQD 2 TM 1	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 2ND PLT SQD 2 TM 2	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 2ND PLT SQD 2 TM 3	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 2ND PLT SQD 3 HQ TM	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 2ND PLT SQD 3 TM 1	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 2ND PLT SQD 3 TM 2	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 2ND PLT SQD 3 TM 3	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 3RD PLT HQ SQD	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 3RD PLT SQD 1 HQ TM	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 3RD PLT SQD 1 TM 1	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 3RD PLT SQD 1 TM 2	GCE	1			1			1			1			1		

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1			Mix 2			Mix 3			Mix 4			Mix 5		
INF BN 2 (VERT) CO E 3RD PLT SQD 1 TM 3	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 3RD PLT SQD 2 HQ TM	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 3RD PLT SQD 2 TM 1	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 3RD PLT SQD 2 TM 2	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 3RD PLT SQD 2 TM 3	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 3RD PLT SQD 3 HQ TM	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 3RD PLT SQD 3 TM 1	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 3RD PLT SQD 3 TM 2	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E 3RD PLT SQD 3 TM 3	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E HQ PLT	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT 60MM SECT H(	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT 60MM SECT S(	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT 60MM SECT S(	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT 60MM SECT S(	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT ASLT SECT HC	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT ASLT SECT SC	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT ASLT SECT SC	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT ASLT SECT SC	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT HQ SECT	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT MG SECT HQ S	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT MG SECT SQD	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT MG SECT SQD	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT MG SECT SQD	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT MG SECT SQD	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT MG SECT SQD	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT MG SECT SQD	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT MG SECT SQD	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT MG SECT SQD	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO E WPNS PLT MG SECT SQD	GCE	1			1			1			1			1		
INF BN 2 (VERT) CO F 1ST PLT HQ SQD	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 1ST PLT SQD 1 HQ TM	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 1ST PLT SQD 1 TM 1	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 1ST PLT SQD 1 TM 2	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 1ST PLT SQD 1 TM 3	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 1ST PLT SQD 2 HQ TM	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 1ST PLT SQD 2 TM 1	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 1ST PLT SQD 2 TM 2	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 1ST PLT SQD 2 TM 3	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 1ST PLT SQD 3 HQ TM	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 1ST PLT SQD 3 TM 1	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 1ST PLT SQD 3 TM 2	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 1ST PLT SQD 3 TM 3	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 2ND PLT HQ SQD	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 2ND PLT SQD 1 HQ TM	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 2ND PLT SQD 1 TM 1	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 2ND PLT SQD 1 TM 2	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 2ND PLT SQD 1 TM 3	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 2ND PLT SQD 2 HQ TM	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 2ND PLT SQD 2 TM 1	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 2ND PLT SQD 2 TM 2	GCE	1			1			1				1			1	
INF BN 2 (VERT) CO F 2ND PLT SQD 2 TM 3	GCE	1			1			1				1			1	

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
INF BN 2 (VERT) CO F 2ND PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 2ND PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 2ND PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 2ND PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 3RD PLT HQ SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 3RD PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 3RD PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 3RD PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 3RD PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 3RD PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 3RD PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 3RD PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 3RD PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 3RD PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 3RD PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 3RD PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F 3RD PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F HQ PLT	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT 60MM SECT H	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT 60MM SECT S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT 60MM SECT S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT 60MM SECT S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT ASLT SECT H	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT ASLT SECT S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT ASLT SECT S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT ASLT SECT S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT HQ SECT	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT MG SECT HQ S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO F WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 1ST PLT HQ SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 1ST PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 1ST PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 1ST PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 1ST PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 1ST PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 1ST PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 1ST PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 1ST PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 1ST PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 1ST PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 1ST PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 1ST PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 2ND PLT HQ SQD	GCE	1	1	1	1	1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
INF BN 2 (VERT) CO G 2ND PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 2ND PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 2ND PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 2ND PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 2ND PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 2ND PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 2ND PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 2ND PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 2ND PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 2ND PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 2ND PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 2ND PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 3RD PLT HQ SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 3RD PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 3RD PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 3RD PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 3RD PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 3RD PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 3RD PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 3RD PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 3RD PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 3RD PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 3RD PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 3RD PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G 3RD PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G HQ PLT	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT 60MM SECT H	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT 60MM SECT S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT 60MM SECT S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT 60MM SECT S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT ASLT SECT H	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT ASLT SECT S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT ASLT SECT S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT ASLT SECT S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT HQ SECT	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT MG SECT HQ S	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) CO G WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 2 (VERT) H&S CO BN HQ	GCE	1	1	1	1	1
INF BN 2 (VERT) H&S CO CHAP SHOP	GCE	1	1	1	1	1
INF BN 2 (VERT) H&S CO HQ PLT	GCE	1	1	1	1	1
INF BN 2 (VERT) H&S CO MED SHOP BAS 1	GCE	1	1	1	1	1
INF BN 2 (VERT) H&S CO MED SHOP BAS 2	GCE	1	1	1	1	1
INF BN 2 (VERT) H&S CO MED SHOP CO TM E	GCE	1	1	1	1	1

Assumption: Units deploy with 100% of their assets. Binary system used.

Unit	Type	Mix 1		Mix 2		Mix 3			Mix 4			Mix 5	
INF BN 2 (VERT) H&S CO MED SHOP CO TM F	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO MED SHOP CO TM G	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO MED SHOP CO TM W	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S1 SHOP	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S2 SHOP HQ PLT	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S2 SHOP INTEL PLT	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S2 SHOP SNIP PLT	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S3 SHOP DIST OPS SE	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S3 SHOP OPS PLT AIR	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S3 SHOP OPS PLT CBI	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S3 SHOP OPS PLT HQ	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S3 SHOP OPS PLT IO (	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S4 SHOP LOG SECT	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S4 SHOP SERV PLT AF	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S4 SHOP SERV PLT DF	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S4 SHOP SERV PLT H(	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S4 SHOP SERV PLT MT	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S4 SHOP SERV PLT SU	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S4 SHOP SERV PLT TC	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S6 SHOP DATA SECT	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S6 SHOP HQ SECT	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S6 SHOP MAINT SECT	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S6 SHOP MORT SECT I	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S6 SHOP MORT SECT I	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S6 SHOP MORT SECT I	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S6 SHOP MORT SECT I	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S6 SHOP RADIO SECT	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S6 SHOP TACP SECT F	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S6 SHOP TACP SECT F	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S6 SHOP TACP SECT 1	GCE	1		1			1			1			1
INF BN 2 (VERT) H&S CO S6 SHOP WIRE SECT	GCE	1		1			1			1			1
INF BN 2 (VERT) WPNS CO 81MM PLT FDC 1	GCE	1	1		1				1			1	
INF BN 2 (VERT) WPNS CO 81MM PLT FDC 2	GCE	1	1		1				1			1	
INF BN 2 (VERT) WPNS CO 81MM PLT HQ SECT	GCE	1	1		1				1			1	
INF BN 2 (VERT) WPNS CO 81MM PLT SECT 1 HQ	GCE	1	1		1				1			1	
INF BN 2 (VERT) WPNS CO 81MM PLT SECT 1 SQ	GCE	1	1		1				1			1	
INF BN 2 (VERT) WPNS CO 81MM PLT SECT 1 SQ	GCE	1	1		1				1			1	
INF BN 2 (VERT) WPNS CO 81MM PLT SECT 1 SQ	GCE	1	1		1				1			1	
INF BN 2 (VERT) WPNS CO 81MM PLT SECT 1 SQ	GCE	1	1		1				1			1	
INF BN 2 (VERT) WPNS CO 81MM PLT SECT 2 HC	GCE	1	1		1				1			1	
INF BN 2 (VERT) WPNS CO 81MM PLT SECT 2 SC	GCE	1	1		1				1			1	
INF BN 2 (VERT) WPNS CO 81MM PLT SECT 2 SC	GCE	1	1		1				1			1	
INF BN 2 (VERT) WPNS CO 81MM PLT SECT 2 SC	GCE	1	1		1				1			1	
INF BN 2 (VERT) WPNS CO 81MM PLT SECT 2 SC	GCE	1	1		1				1			1	
INF BN 2 (VERT) WPNS CO AA PLT HQ SECT	GCE	1	1			1			1				1
INF BN 2 (VERT) WPNS CO AA PLT JAV SECT HC	GCE	1	1			1			1				1
INF BN 2 (VERT) WPNS CO AA PLT JAV SECT SC	GCE	1	1			1			1				1
INF BN 2 (VERT) WPNS CO AA PLT JAV SECT SC	GCE	1	1			1			1				1
INF BN 2 (VERT) WPNS CO AA PLT TOW SECT H	GCE	1	1			1			1				1
INF BN 2 (VERT) WPNS CO AA PLT TOW SECT S	GCE	1	1			1			1				1
INF BN 2 (VERT) WPNS CO AA PLT TOW SECT S	GCE	1	1			1			1				1

Assumption: Units deploy with 100% of their assets. Binary system used.

Unit	Type	Mix 1		Mix 2		Mix 3			Mix 4			Mix 5	
INF BN 2 (VERT) WPNS CO AA PLT TOW SECT S	GCE	1	1			1			1				1
INF BN 2 (VERT) WPNS CO AA PLT TOW SECT S	GCE	1	1			1			1				1
INF BN 2 (VERT) WPNS CO HMG PLT HQ SECT	GCE	1	1		1			1			1		
INF BN 2 (VERT) WPNS CO HMG PLT SECT 1 SQI	GCE	1	1		1			1			1		
INF BN 2 (VERT) WPNS CO HMG PLT SECT 1 SQI	GCE	1	1		1			1			1		
INF BN 2 (VERT) WPNS CO HMG PLT SECT 2 SQ	GCE	1	1		1			1			1		
INF BN 2 (VERT) WPNS CO HMG PLT SECT 2 SQ	GCE	1	1		1			1			1		
INF BN 2 (VERT) WPNS CO HMG PLT SECT 3 SQ	GCE	1	1		1			1			1		
INF BN 2 (VERT) WPNS CO HMG PLT SECT 3 SQ	GCE	1	1		1			1			1		
INF BN 2 (VERT) WPNS CO HQ PLT	GCE	1	1		1				1			1	
INF BN 3 (SURF) CO I 1ST PLT HQ SQD	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 1ST PLT SQD 1 HQ TM	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 1ST PLT SQD 1 TM 1	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 1ST PLT SQD 1 TM 2	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 1ST PLT SQD 1 TM 3	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 1ST PLT SQD 2 HQ TM	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 1ST PLT SQD 2 TM 1	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 1ST PLT SQD 2 TM 2	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 1ST PLT SQD 2 TM 3	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 1ST PLT SQD 3 HQ TM	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 1ST PLT SQD 3 TM 1	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 1ST PLT SQD 3 TM 2	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 1ST PLT SQD 3 TM 3	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 2ND PLT HQ SQD	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 2ND PLT SQD 1 HQ TM	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 2ND PLT SQD 1 TM 1	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 2ND PLT SQD 1 TM 2	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 2ND PLT SQD 1 TM 3	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 2ND PLT SQD 2 HQ TM	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 2ND PLT SQD 2 TM 1	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 2ND PLT SQD 2 TM 2	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 2ND PLT SQD 2 TM 3	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 2ND PLT SQD 3 HQ TM	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 2ND PLT SQD 3 TM 1	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 2ND PLT SQD 3 TM 2	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 2ND PLT SQD 3 TM 3	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 3RD PLT HQ SQD	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 3RD PLT SQD 1 HQ TM	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 3RD PLT SQD 1 TM 1	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 3RD PLT SQD 1 TM 2	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 3RD PLT SQD 1 TM 3	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 3RD PLT SQD 2 HQ TM	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 3RD PLT SQD 2 TM 1	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 3RD PLT SQD 2 TM 2	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 3RD PLT SQD 2 TM 3	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 3RD PLT SQD 3 HQ TM	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 3RD PLT SQD 3 TM 1	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 3RD PLT SQD 3 TM 2	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I 3RD PLT SQD 3 TM 3	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I HQ PLT	GCE	1	1		1			1			1		
INF BN 3 (SURF) CO I WPNS PLT 60MM SECT HQ	GCE	1	1		1			1			1		

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
INF BN 3 (SURF) CO I WPNS PLT 60MM SECT SG	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT 60MM SECT SG	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT 60MM SECT SG	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT ASLT SECT HQ	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT ASLT SECT SQ	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT ASLT SECT SQ	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT ASLT SECT SQ	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT HQ SECT	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT MG SECT HQ S	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO I WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 1ST PLT HQ SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 1ST PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 1ST PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 1ST PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 1ST PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 1ST PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 1ST PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 1ST PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 1ST PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 1ST PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 1ST PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 1ST PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 1ST PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 2ND PLT HQ SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 2ND PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 2ND PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 2ND PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 2ND PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 2ND PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 2ND PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 2ND PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 2ND PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 2ND PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 2ND PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 2ND PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 2ND PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 3RD PLT HQ SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 3RD PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 3RD PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 3RD PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 3RD PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 3RD PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 3RD PLT SQD 2 TM 1	GCE	1	1	1	1	1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
INF BN 3 (SURF) CO K 3RD PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 3RD PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 3RD PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 3RD PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 3RD PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K 3RD PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K HQ PLT	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT 60MM SECT H	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT 60MM SECT S	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT 60MM SECT S	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT 60MM SECT S	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT ASLT SECT H	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT ASLT SECT S	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT ASLT SECT S	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT ASLT SECT S	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT HQ SECT	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT MG SECT HQ	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO K WPNS PLT MG SECT SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 1ST PLT HQ SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 1ST PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 1ST PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 1ST PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 1ST PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 1ST PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 1ST PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 1ST PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 1ST PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 1ST PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 1ST PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 1ST PLT SQD 3 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 1ST PLT SQD 3 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 2ND PLT HQ SQD	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 2ND PLT SQD 1 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 2ND PLT SQD 1 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 2ND PLT SQD 1 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 2ND PLT SQD 1 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 2ND PLT SQD 2 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 2ND PLT SQD 2 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 2ND PLT SQD 2 TM 2	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 2ND PLT SQD 2 TM 3	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 2ND PLT SQD 3 HQ TM	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 2ND PLT SQD 3 TM 1	GCE	1	1	1	1	1
INF BN 3 (SURF) CO L 2ND PLT SQD 3 TM 2	GCE	1	1	1	1	1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1			Mix 2			Mix 3			Mix 4			Mix 5		
INF BN 3 (SURF) CO L 2ND PLT SQD 3 TM 3	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L 3RD PLT HQ SQD	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L 3RD PLT SQD 1 HQ TM	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L 3RD PLT SQD 1 TM 1	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L 3RD PLT SQD 1 TM 2	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L 3RD PLT SQD 1 TM 3	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L 3RD PLT SQD 2 HQ TM	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L 3RD PLT SQD 2 TM 1	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L 3RD PLT SQD 2 TM 2	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L 3RD PLT SQD 2 TM 3	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L 3RD PLT SQD 3 HQ TM	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L 3RD PLT SQD 3 TM 1	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L 3RD PLT SQD 3 TM 2	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L 3RD PLT SQD 3 TM 3	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L HQ PLT	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT 60MM SECT H(	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT 60MM SECT S(	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT 60MM SECT S(	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT 60MM SECT S(	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT ASLT SECT H(	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT ASLT SECT S(	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT ASLT SECT S(	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT ASLT SECT S(	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT HQ SECT	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT MG SECT HQ S	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT MG SECT SQD	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT MG SECT SQD	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT MG SECT SQD	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT MG SECT SQD	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT MG SECT SQD	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT MG SECT SQD	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT MG SECT SQD	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT MG SECT SQD	GCE	1			1				1			1				1
INF BN 3 (SURF) CO L WPNS PLT MG SECT SQD	GCE	1			1				1			1				1
INF BN 3 (SURF) H&S CO BN HQ	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO CHAP SHOP	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO HQ PLT	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO MED SHOP BAS 1	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO MED SHOP BAS 2	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO MED SHOP CO TM I	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO MED SHOP CO TM K	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO MED SHOP CO TM L	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO MED SHOP CO TM W	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S1 SHOP	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S2 SHOP HQ PLT	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S2 SHOP INTEL PLT	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S2 SHOP SNIP PLT	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S3 SHOP DIST OPS SE	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S3 SHOP OPS PLT AIF	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S3 SHOP OPS PLT CB	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S3 SHOP OPS PLT HQ	GCE	1				1				1			1			1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1			Mix 2			Mix 3			Mix 4			Mix 5		
INF BN 3 (SURF) H&S CO S3 SHOP OPS PLT IO (	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S4 SHOP LOG SECT	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S4 SHOP SERV PLT AI	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S4 SHOP SERV PLT DI	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S4 SHOP SERV PLT H(	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S4 SHOP SERV PLT M'	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S4 SHOP SERV PLT S(	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S4 SHOP SERV PLT T(	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S6 SHOP DATA SECT	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S6 SHOP HQ SECT	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S6 SHOP MAINT SECT	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S6 SHOP MORT SECT	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S6 SHOP MORT SECT	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S6 SHOP MORT SECT	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S6 SHOP MORT SECT	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S6 SHOP RADIO SECT	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S6 SHOP TACP SECT I	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S6 SHOP TACP SECT I	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S6 SHOP TACP SECT '	GCE	1				1				1			1			1
INF BN 3 (SURF) H&S CO S6 SHOP WIRE SECT	GCE	1				1				1			1			1
INF BN 3 (SURF) WPNS CO 81MM PLT FDC 1	GCE	1			1			1				1			1	
INF BN 3 (SURF) WPNS CO 81MM PLT FDC 2	GCE	1			1			1				1			1	
INF BN 3 (SURF) WPNS CO 81MM PLT HQ SECT	GCE	1			1			1				1			1	
INF BN 3 (SURF) WPNS CO 81MM PLT SECT 1 HG	GCE	1			1			1				1			1	
INF BN 3 (SURF) WPNS CO 81MM PLT SECT 1 SG	GCE	1			1			1				1			1	
INF BN 3 (SURF) WPNS CO 81MM PLT SECT 1 SG	GCE	1			1			1				1			1	
INF BN 3 (SURF) WPNS CO 81MM PLT SECT 1 SG	GCE	1			1			1				1			1	
INF BN 3 (SURF) WPNS CO 81MM PLT SECT 1 SG	GCE	1			1			1				1			1	
INF BN 3 (SURF) WPNS CO 81MM PLT SECT 2 H(	GCE	1			1			1				1			1	
INF BN 3 (SURF) WPNS CO 81MM PLT SECT 2 S(	GCE	1			1			1				1			1	
INF BN 3 (SURF) WPNS CO 81MM PLT SECT 2 S(	GCE	1			1			1				1			1	
INF BN 3 (SURF) WPNS CO 81MM PLT SECT 2 S(	GCE	1			1			1				1			1	
INF BN 3 (SURF) WPNS CO 81MM PLT SECT 2 S(	GCE	1			1			1				1			1	
INF BN 3 (SURF) WPNS CO AA PLT HQ SECT	GCE	1			1				1			1				1
INF BN 3 (SURF) WPNS CO AA PLT JAV SECT H(	GCE	1			1				1			1				1
INF BN 3 (SURF) WPNS CO AA PLT JAV SECT S(	GCE	1			1				1			1				1
INF BN 3 (SURF) WPNS CO AA PLT JAV SECT S(	GCE	1			1				1			1				1
INF BN 3 (SURF) WPNS CO AA PLT TOW SECT H	GCE	1			1				1			1				1
INF BN 3 (SURF) WPNS CO AA PLT TOW SECT S	GCE	1			1				1			1				1
INF BN 3 (SURF) WPNS CO AA PLT TOW SECT S	GCE	1			1				1			1				1
INF BN 3 (SURF) WPNS CO AA PLT TOW SECT S	GCE	1			1				1			1				1
INF BN 3 (SURF) WPNS CO AA PLT TOW SECT S	GCE	1			1				1			1				1
INF BN 3 (SURF) WPNS CO HMG PLT HQ SECT	GCE	1			1			1			1			1		
INF BN 3 (SURF) WPNS CO HMG PLT SECT 1 SQI	GCE	1			1			1			1			1		
INF BN 3 (SURF) WPNS CO HMG PLT SECT 1 SQI	GCE	1			1			1			1			1		
INF BN 3 (SURF) WPNS CO HMG PLT SECT 2 SQ	GCE	1			1			1			1			1		
INF BN 3 (SURF) WPNS CO HMG PLT SECT 2 SQ	GCE	1			1			1			1			1		
INF BN 3 (SURF) WPNS CO HMG PLT SECT 3 SQ	GCE	1			1			1			1			1		
INF BN 3 (SURF) WPNS CO HMG PLT SECT 3 SQ	GCE	1			1			1			1			1		
INF BN 3 (SURF) WPNS CO HQ PLT	GCE	1			1			1				1			1	
INF REGT HQ CO CHAP SECT	GCE	1				1				1			1			1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1			Mix 2			Mix 3			Mix 4			Mix 5		
INF REGT HQ CO CMD SECT	GCE	1				1				1			1			1
INF REGT HQ CO COMM PLT DATA SECT	GCE	1				1				1			1			1
INF REGT HQ CO COMM PLT HQ SECT	GCE	1				1				1			1			1
INF REGT HQ CO COMM PLT MAINT SECT	GCE	1				1				1			1			1
INF REGT HQ CO COMM PLT RADIO SECT	GCE	1				1				1			1			1
INF REGT HQ CO COMM PLT TACP SECT	GCE	1				1				1			1			1
INF REGT HQ CO COMM PLT WIRE SECT	GCE	1				1				1			1			1
INF REGT HQ CO HQ SECT	GCE	1				1				1			1			1
INF REGT HQ CO MED SECT	GCE	1				1				1			1			1
INF REGT HQ CO MESS SECT	GCE	1				1				1			1			1
INF REGT HQ CO MT SECT	GCE	1				1				1			1			1
INF REGT HQ CO S1 SECT	GCE	1				1				1			1			1
INF REGT HQ CO S1 SECT HUMAN AFF UNIT	GCE	1				1				1			1			1
INF REGT HQ CO S2 SECT	GCE	1				1				1			1			1
INF REGT HQ CO S3 SECT	GCE	1				1				1			1			1
INF REGT HQ CO S4 SECT	GCE	1				1				1			1			1
INF REGT HQ CO SUPP SECT	GCE	1				1				1			1			1
LAR BN CO A 1ST PLT 1ST SQD	GCE	1			1			1			1			1		
LAR BN CO A 1ST PLT 2ND SQD	GCE	1			1			1			1			1		
LAR BN CO A 1ST PLT HQ SQD	GCE	1			1			1			1			1		
LAR BN CO A 2ND PLT 1ST SQD	GCE	1			1			1				1			1	
LAR BN CO A 2ND PLT 2ND SQD	GCE	1			1			1				1			1	
LAR BN CO A 2ND PLT HQ SQD	GCE	1			1			1				1			1	
LAR BN CO A 3RD PLT 1ST SQD	GCE	1			1				1			1				1
LAR BN CO A 3RD PLT 2ND SQD	GCE	1			1				1			1				1
LAR BN CO A 3RD PLT HQ SQD	GCE	1			1				1			1				1
LAR BN CO A HQ PLT 81MM SECT SQD A	GCE	1			1			1				1			1	
LAR BN CO A HQ PLT 81MM SECT SQD B	GCE	1			1			1				1			1	
LAR BN CO A HQ PLT AT SECT TM A	GCE	1			1			1				1			1	
LAR BN CO A HQ PLT AT SECT TM B	GCE	1			1			1				1			1	
LAR BN CO A HQ PLT HQ SECT	GCE	1			1			1				1			1	
LAR BN CO A HQ PLT LOG SECT	GCE	1			1			1				1			1	
LAR BN CO A HQ PLT SCOUT TM SECT	GCE	1			1			1			1			1		
LAR BN CO B 1ST PLT 1ST SQD	GCE	1			1			1			1			1		
LAR BN CO B 1ST PLT 2ND SQD	GCE	1			1			1			1			1		
LAR BN CO B 1ST PLT HQ SQD	GCE	1			1			1			1			1		
LAR BN CO B 2ND PLT 1ST SQD	GCE	1			1			1				1			1	
LAR BN CO B 2ND PLT 2ND SQD	GCE	1			1			1				1			1	
LAR BN CO B 2ND PLT HQ SQD	GCE	1			1			1				1			1	
LAR BN CO B 3RD PLT 1ST SQD	GCE	1			1				1			1				1
LAR BN CO B 3RD PLT 2ND SQD	GCE	1			1				1			1				1
LAR BN CO B 3RD PLT HQ SQD	GCE	1			1				1			1				1
LAR BN CO B HQ PLT 81MM SECT SQD A	GCE	1			1			1				1			1	
LAR BN CO B HQ PLT 81MM SECT SQD B	GCE	1			1			1				1			1	
LAR BN CO B HQ PLT AT SECT TM A	GCE	1			1			1				1			1	
LAR BN CO B HQ PLT AT SECT TM B	GCE	1			1			1				1			1	
LAR BN CO B HQ PLT HQ SECT	GCE	1			1			1				1			1	
LAR BN CO B HQ PLT LOG SECT	GCE	1			1			1				1			1	
LAR BN CO B HQ PLT SCOUT TM SECT	GCE	1			1			1			1			1		
LAR BN H&S CO AMBUL SECT	GCE	1				1				1			1			1
LAR BN H&S CO BN AID STA 1	GCE	1				1				1			1			1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1			Mix 2			Mix 3			Mix 4			Mix 5		
LAR BN H&S CO CMD SECT	GCE	1				1				1			1			1
LAR BN H&S CO COMM PLT DATA SECT	GCE	1				1				1			1			1
LAR BN H&S CO COMM PLT EPLRS SECT	GCE	1				1				1			1			1
LAR BN H&S CO COMM PLT HQ SECT	GCE	1				1				1			1			1
LAR BN H&S CO COMM PLT RADIO SECT	GCE	1				1				1			1			1
LAR BN H&S CO COMM PLT WIRE SECT	GCE	1				1				1			1			1
LAR BN H&S CO DIN FAC SECT	GCE	1				1				1			1			1
LAR BN H&S CO HQ SECT	GCE	1				1				1			1			1
LAR BN H&S CO LIGHT VEH SECT	GCE	1				1				1			1			1
LAR BN H&S CO LVS SECT	GCE	1				1				1			1			1
LAR BN H&S CO MAINT PLT ARM SECT	GCE	1				1				1			1			1
LAR BN H&S CO MAINT PLT ENGR SECT	GCE	1				1				1			1			1
LAR BN H&S CO MAINT PLT HQ SECT	GCE	1				1				1			1			1
LAR BN H&S CO MAINT PLT OPTICS REPAIR SE	GCE	1				1				1			1			1
LAR BN H&S CO MAINT PLT RECOVERY SECT	GCE	1				1				1			1			1
LAR BN H&S CO MAINT PLT REPAIR SECT	GCE	1				1				1			1			1
LAR BN H&S CO MED TM A	GCE	1				1				1			1			1
LAR BN H&S CO MED TM B	GCE	1				1				1			1			1
LAR BN H&S CO MED TM H&S	GCE	1				1				1			1			1
LAR BN H&S CO MT PLT	GCE	1				1				1			1			1
LAR BN H&S CO MV REPAIR SECT	GCE	1				1				1			1			1
LAR BN H&S CO S1 SECT	GCE	1				1				1			1			1
LAR BN H&S CO S2 SECT	GCE	1				1				1			1			1
LAR BN H&S CO S3 SECT	GCE	1				1				1			1			1
LAR BN H&S CO S4 SECT	GCE	1				1				1			1			1
LAR BN H&S CO SCOUT TM	GCE	1				1				1			1			1
LAR BN H&S CO SVC PLT HQ SECT	GCE	1				1				1			1			1
LAR BN H&S CO SVC PLT REFUELER SECT	GCE	1				1				1			1			1
LAR BN H&S CO SVC PLT SUPP SECT	GCE	1				1				1			1			1
LAR BN H&S CO SVC PLT TACP SECT	GCE	1				1				1			1			1
LAR BN H&S CO SVC PLT TRUCK SECT 1	GCE	1				1				1			1			1
LAR BN H&S CO SVC PLT TRUCK SECT 2	GCE	1				1				1			1			1
RECON BN CO A 1ST PLT HQ TM	GCE	1			1			1			1			1		
RECON BN CO A 1ST PLT TM A	GCE	1			1			1			1			1		
RECON BN CO A 1ST PLT TM B	GCE	1			1			1			1			1		
RECON BN CO A 1ST PLT TM C	GCE	1			1			1			1			1		
RECON BN CO A 2ND PLT HQ TM	GCE	1			1			1			1			1		
RECON BN CO A 2ND PLT TM A	GCE	1			1			1			1			1		
RECON BN CO A 2ND PLT TM B	GCE	1			1			1			1			1		
RECON BN CO A 2ND PLT TM C	GCE	1			1			1			1			1		
RECON BN CO A 3RD PLT HQ TM	GCE	1			1			1				1			1	
RECON BN CO A 3RD PLT TM A	GCE	1			1			1				1			1	
RECON BN CO A 3RD PLT TM B	GCE	1			1			1				1			1	
RECON BN CO A 3RD PLT TM C	GCE	1			1			1				1			1	
RECON BN CO A 4TH PLT HQ TM	GCE	1			1				1			1				1
RECON BN CO A 4TH PLT TM A	GCE	1			1				1			1				1
RECON BN CO A 4TH PLT TM B	GCE	1			1				1			1				1
RECON BN CO A 4TH PLT TM C	GCE	1			1				1			1				1
RECON BN CO A HQ PLT	GCE	1			1			1				1			1	
TANK BN CO A 1ST PLT 1ST SECT	GCE	1			1			1			1			1		
TANK BN CO A 1ST PLT 2ND SECT	GCE	1			1			1			1			1		

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1			Mix 2			Mix 3			Mix 4			Mix 5		
TANK BN CO A 1ST PLT 3RD SECT	GCE	1			1			1			1			1		
TANK BN CO A 1ST PLT HQ SECT	GCE	1			1			1			1			1		
TANK BN CO A 2ND PLT 1ST SECT	GCE	1			1			1				1			1	
TANK BN CO A 2ND PLT 2ND SECT	GCE	1			1			1				1			1	
TANK BN CO A 2ND PLT 3RD SECT	GCE	1			1			1				1			1	
TANK BN CO A 2ND PLT HQ SECT	GCE	1			1			1				1			1	
TANK BN CO A 3RD PLT 1ST SECT	GCE	1			1				1			1				1
TANK BN CO A 3RD PLT 2ND SECT	GCE	1			1				1			1				1
TANK BN CO A 3RD PLT 3RD SECT	GCE	1			1				1			1				1
TANK BN CO A 3RD PLT HQ SECT	GCE	1			1				1			1				1
TANK BN CO A HQ PLT	GCE	1			1			1				1			1	
TANK BN CO A HQ PLT MAINT SECT	GCE	1			1			1				1			1	
TANK BN CO A HQ PLT OPS SECT	GCE	1			1			1				1			1	
TANK BN CO A HQ PLT TANK SECT	GCE	1			1			1				1			1	
TANK BN CO B 1ST PLT 1ST SECT	GCE	1			1			1			1			1		
TANK BN CO B 1ST PLT 2ND SECT	GCE	1			1			1			1			1		
TANK BN CO B 1ST PLT 3RD SECT	GCE	1			1			1			1			1		
TANK BN CO B 1ST PLT HQ SECT	GCE	1			1			1			1			1		
TANK BN CO B 2ND PLT 1ST SECT	GCE	1			1			1				1			1	
TANK BN CO B 2ND PLT 2ND SECT	GCE	1			1			1				1			1	
TANK BN CO B 2ND PLT 3RD SECT	GCE	1			1			1				1			1	
TANK BN CO B 2ND PLT HQ SECT	GCE	1			1			1				1			1	
TANK BN CO B 3RD PLT 1ST SECT	GCE	1			1				1			1				1
TANK BN CO B 3RD PLT 2ND SECT	GCE	1			1				1			1				1
TANK BN CO B 3RD PLT 3RD SECT	GCE	1			1				1			1				1
TANK BN CO B 3RD PLT HQ SECT	GCE	1			1				1			1				1
TANK BN CO B HQ PLT	GCE	1			1			1				1			1	
TANK BN CO B HQ PLT MAINT SECT	GCE	1			1			1				1			1	
TANK BN CO B HQ PLT OPS SECT	GCE	1			1			1				1			1	
TANK BN CO B HQ PLT TANK SECT	GCE	1			1			1				1			1	
TANK BN H&S CO AT PLT 1ST SECT 1ST SQD	GCE	1				1				1			1			1
TANK BN H&S CO AT PLT 1ST SECT 2ND SQD	GCE	1				1				1			1			1
TANK BN H&S CO AT PLT 1ST SECT 3RD SQD	GCE	1				1				1			1			1
TANK BN H&S CO AT PLT 1ST SECT 4TH SQD	GCE	1				1				1			1			1
TANK BN H&S CO AT PLT 1ST SECT HQ SQD	GCE	1				1				1			1			1
TANK BN H&S CO AT PLT 2ND SECT 1ST SQD	GCE	1				1				1			1			1
TANK BN H&S CO AT PLT 2ND SECT 2ND SQD	GCE	1				1				1			1			1
TANK BN H&S CO AT PLT 2ND SECT 3RD SQD	GCE	1				1				1			1			1
TANK BN H&S CO AT PLT 2ND SECT 4TH SQD	GCE	1				1				1			1			1
TANK BN H&S CO AT PLT 2ND SECT HQ SQD	GCE	1				1				1			1			1
TANK BN H&S CO AT PLT HQ SECT	GCE	1				1				1			1			1
TANK BN H&S CO AT PLT MAINT SECT	GCE	1				1				1			1			1
TANK BN H&S CO AVLB SECT	GCE	1				1				1			1			1
TANK BN H&S CO CMD SECT	GCE	1				1				1			1			1
TANK BN H&S CO COMM PLT	GCE	1				1				1			1			1
TANK BN H&S CO DIN FAC SECT	GCE	1				1				1			1			1
TANK BN H&S CO HQ SECT	GCE	1				1				1			1			1
TANK BN H&S CO MAINT PLT HQ SECT	GCE	1				1				1			1			1
TANK BN H&S CO MED SECT	GCE	1				1				1			1			1
TANK BN H&S CO MT PLT	GCE	1				1				1			1			1
TANK BN H&S CO MV SECT	GCE	1				1				1			1			1

Assumption: Units deploy with 100% of their assets. Binary system used.

		Mix 1			Mix 2			Mix 3			Mix 4			Mix 5		
TANK BN H&S CO ORD SECT	GCE	1				1				1			1			1
TANK BN H&S CO S4 SECT	GCE	1				1				1			1			1
TANK BN H&S CO SUPP PLT	GCE	1				1				1			1			1
TANK BN H&S CO TANK SECT 1	GCE	1				1				1			1			1
TANK BN H&S CO TANK SECT 2	GCE	1				1				1			1			1

APPENDIX B. SUMMARY MPEM OUTPUT DATA

30 DAY TOTAL (Gal Fuel)

	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	
High UR (1)	1,468,290	1,361,072	1,073,033	978,825	879,863	High OM (1)
	1,297,722	1,204,263	952,159	868,294	779,792	Med High OM (2)
	956,587	890,645	710,410	647,233	579,650	Med Low OM (3)
	786,019	733,836	589,536	536,702	479,579	Low OM (4)
Med High UR (2)	1,292,163	1,197,003	942,566	859,390	772,483	High OM (1)
	1,142,362	1,059,352	836,507	762,461	684,741	Med High OM (2)
	842,758	784,048	624,390	568,605	509,255	Med Low OM (3)
	692,957	646,397	518,331	471,676	421,513	Low OM (4)
Med Low UR (3)	1,053,590	974,963	766,889	698,452	627,627	High OM (1)
	931,545	862,916	680,624	619,698	556,359	Med High OM (2)
	687,454	638,821	508,093	462,190	413,823	Med Low OM (3)
	565,408	526,774	421,827	383,436	342,554	Low OM (4)
Low UR (4)	873,786	807,878	634,971	577,605	518,841	High OM (1)
	772,569	715,041	563,554	512,484	459,931	Med High OM (2)
	570,134	529,368	420,719	382,242	342,112	Med Low OM (3)
	468,917	436,532	349,302	317,121	283,203	Low OM (4)

AVG DAILY REQUIREMENT (Gal Fuel)

	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	
High UR (1)	48,943.01	45,369.05	35,767.76	32,627.50	29,328.78	High OM (1)
	43,257.41	40,142.09	31,738.62	28,943.14	25,993.08	Med High OM (2)
	31,886.22	29,688.16	23,680.34	21,574.42	19,321.67	Med Low OM (3)
	26,200.62	24,461.20	19,651.20	17,890.06	15,985.96	Low OM (4)
Med High UR (2)	43,072.12	39,900.10	31,418.87	28,646.33	25,749.45	High OM (1)
	38,078.73	35,311.72	27,883.57	25,415.38	22,824.69	Med High OM (2)
	28,091.95	26,134.95	20,812.99	18,953.49	16,975.18	Med Low OM (3)
	23,098.56	21,546.56	17,277.69	15,722.54	14,050.42	Low OM (4)
Med Low UR (3)	35,119.68	32,498.76	25,562.98	23,281.74	20,920.89	High OM (1)
	31,051.50	28,763.85	22,687.46	20,656.60	18,545.29	Med High OM (2)
	22,915.13	21,294.04	16,936.42	15,406.32	13,794.09	Med Low OM (3)
	18,846.95	17,559.14	14,060.90	12,781.18	11,418.48	Low OM (4)
Low UR (4)	29,126.20	26,929.25	21,165.69	19,253.48	17,294.70	High OM (1)
	25,752.29	23,834.71	18,785.12	17,082.79	15,331.04	Med High OM (2)
	19,004.47	17,645.61	14,023.98	12,741.40	11,403.74	Med Low OM (3)
	15,630.55	14,551.06	11,643.41	10,570.71	9,440.08	Low OM (4)

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APPENDIX C. REGRESSION DATA AND COMPARISON

A. MAIN EFFECTS MODEL

Main Effects OLS Regression Summary

	Total GCE		AA Bn		Arty Bn(+)		CEB		Div HQ Det	
Mean	708,272.8		223,446.6		117,474.1		44,224.1		17,595.6	
R Square	0.956849		0.986099		0.957841		0.929901		0.913976	
F Test	<.0001		<.0001		<.0001		<.0001		<.0001	
	Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Intercept	1,074,286.7	<.0001	84,975.2	<.0001	236,575.0	<.0001	86,857.1	<.0001	37,337.1	<.0001
Mix 1	179,716.7	<.0001	44,652.1	<.0001	23,775.0	<.0001	20,200.8	<.0001	10,270.2	<.0001
Mix 2	147,424.5	<.0001	39,809.4	<.0001	20,583.3	<.0001	14,579.1	<.0001	7,123.3	<.0001
Mix 3	60,674.5	<.0001	23,367.4	<.0001	11,155.6	<.0001	1,514.6	0.1925	0.0	1.0
Mix 4	31,096.5	0.0028	12,438.8	<.0001	5,009.0	0.0112	763.8	0.5092	0.0	1.0
Utilization Rate	7,241.0	<.0001	2,293.4	<.0001	1,201.4	<.0001	442.9	<.0001	175.1	<.0001
Operation Mode	-11,036.4	<.0001	-246.1	<.0001	-2,670.1	<.0001	-851.1	<.0001	-352.8	<.0001

	Inf Regt		LAR Bn		Recon Co		Tank Bn	
Mean	85,439.7		32,441.5		3,914.2		183,737.0	
R Square	0.939208		0.937410		0.965416		0.955287	
F Test	<.0001		<.0001		<.0001		<.0001	
	Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Intercept	170,259.6	<.0001	67,757.7	<.0001	7,547.2	<.0001	382,978.4	<.0001
Mix 1	30,670.5	<.0001	10,643.4	<.0001	440.7	<.0001	39,064.0	<.0001
Mix 2	22,475.1	<.0001	8,128.5	<.0001	440.7	<.0001	34,285.2	<.0001
Mix 3	3,325.5	0.0852	2,130.3	<.0001	398.4	<.0001	18,782.9	<.0001
Mix 4	1,421.9	0.4580	724.8	0.3246	95.5	0.0908	10,642.7	0.0013
Utilization Rate	869.6	<.0001	332.7	<.0001	40.0	<.0001	1,885.9	<.0001
Operation Mode	-1,803.2	<.0001	-731.7	<.0001	-89.6	<.0001	-4,291.7	<.0001

The main effects model was outperformed by subsequent models based on the R Square value. While an R Square in the low to mid 90s is adequate, the inclusion of additional terms raises the R Square above .99.

Several of the Mix 4 coefficients have high p-values which indicate that the coefficient cannot confidently be stated to be non-zero. Preference will be given to subsequent models which minimize the presence of possibly insignificant coefficients.

B. MAIN EFFECTS + INTERACTION TERMS MODEL

	Main Effects + Interaction Terms OLS Regression Summary									
	Total GCE		**AA Bn**		**Arty Bn(+)**		**CEB**		**Div HQ Det**	
Mean	708,272.8		223,446.6		117,474.1		44,224.1		17,595.6	
R Square	0.999364		0.999973		0.999522		0.998427		0.997856	
F Test	<.0001		<.0001		<.0001		<.0001		<.0001	
	Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Intercept	1,128,852.6	<.0001	22,235.6	<.0001	261,774.6	<.0001	97,654.7	<.0001	43,207.4	<.0001
Mix 1	179,716.7	<.0001	44,652.1	<.0001	23,775.0	<.0001	20,200.8	<.0001	10,270.2	<.0001
Mix 2	147,424.5	<.0001	39,809.4	<.0001	20,583.3	<.0001	14,579.1	<.0001	7,123.3	<.0001
Mix 3	60,674.5	<.0001	23,367.4	<.0001	11,155.6	<.0001	1,514.6	<.0001	0.0	1.0
Mix 4	31,096.5	<.0001	12,438.8	<.0001	5,009.0	<.0001	763.8	<.0001	0.0	1.0
Utilization Rate	9,737.1	<.0001	3,015.3	<.0001	1,562.2	<.0001	657.7	<.0001	275.7	<.0001
Operation Mode	-15,038.7	<.0001	-370.5	<.0001	-3,476.4	<.0001	-1,275.8	<.0001	-562.4	<.0001
Mix 1*UR	1,772.1	<.0001	445.1	<.0001	235.1	<.0001	193.2	<.0001	98.2	<.0001
Mix 1*OM	-2,968.9	<.0001	-117.7	<.0001	-513.8	<.0001	-381.4	<.0001	-206.3	<.0001
Mix 2*UR	1,466.5	<.0001	398.1	<.0001	204.6	<.0001	141.9	<.0001	69.4	<.0001
Mix 2*OM	-2,386.2	<.0001	-83.5	<.0001	-452.0	<.0001	-267.6	<.0001	-143.0	<.0001
Mix 3*UR	604.5	<.0001	233.2	<.0001	110.6	<.0001	15.1	0.1237	0.0	1.0
Mix 3*OM	-876.6	<.0001	-6.1	0.1106	-260.5	<.0001	-31.9	0.0115	0.0	1.0
Mix 4*UR	317.0	<.0001	126.8	<.0001	51.0	<.0001	7.8	0.4238	0.0	1.0
Mix 4*OM	-438.7	<.0001	-0.1	0.9989	-117.5	<.0001	-18.0	0.1476	0.0	1.0
UR*OM	-113.4	<.0001	-2.5	<.0001	-27.4	<.0001	-8.8	<.0001	-3.6	<.0001

	Inf Regt		**LAR Bn**		**Recon Co**		**Tank Bn**	
Mean	85,439.7		32,441.5		3,914.2		183,737.0	
R Square	0.998860		0.998823		0.999779		0.999444	
F Test	<.0001		<.0001		<.0001		<.0001	
	Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Intercept	188,778.6	<.0001	76,835.1	<.0001	8,174.3	<.0001	430,193.9	<.0001
Mix 1	30,670.5	<.0001	10,643.4	<.0001	440.7	<.0001	39,064.0	<.0001
Mix 2	22,475.1	<.0001	8,128.5	<.0001	440.7	<.0001	34,285.2	<.0001
Mix 3	3,325.5	<.0001	2,130.3	<.0001	398.4	<.0001	18,782.9	<.0001
Mix 4	1,421.9	<.0001	724.8	<.0001	95.5	<.0001	10,642.7	<.0001
Utilization Rate	1,212.3	<.0001	462.4	<.0001	48.1	<.0001	2,503.5	<.0001
Operation Mode	-2,497.8	<.0001	-1,021.8	<.0001	-108.5	<.0001	-5,725.6	<.0001
Mix 1*UR	300.4	<.0001	106.1	<.0001	4.3	<.0001	389.7	<.0001
Mix 1*OM	-600.9	<.0001	-236.1	<.0001	-10.1	<.0001	-902.6	<.0001
Mix 2*UR	223.2	<.0001	81.7	<.0001	4.3	<.0001	343.3	<.0001
Mix 2*OM	-445.0	<.0001	-181.0	<.0001	-10.1	<.0001	-795.1	<.0001
Mix 3*UR	33.0	0.0275	20.9	0.0004	3.9	<.0001	187.7	<.0001
Mix 3*OM	-78.3	<.0001	-49.2	<.0001	-9.1	<.0001	-441.6	<.0001
Mix 4*UR	14.5	0.3257	7.4	0.1933	1.0	0.0002	108.5	<.0001
Mix 4*OM	-33.5	0.0760	-17.1	0.0196	-2.2	<.0001	-250.5	<.0001
UR*OM	-18.6	<.0001	-7.5	<.0001	-0.9	<.0001	-44.1	<.0001

The addition of interaction terms to the main effects model improves the R Square values to above .99. This indicates that the model explain nearly all of the variation in the 30-day total fuel consumption data.

This model also has a few high Mix 4 coefficient p-values. These instances seem to occur at roughly the same rate as in the main effects model.

Improvement in the R Square, therefore, is grounds for prefering this model over the main effects model.

C. MAIN EFFECTS + POLYNOMIAL TERMS MODEL

	Main Effects + Polynomial Terms OLS Regression Summary									
	Total GCE		AA Bn		Arty Bn(+)		CEB		Div HQ Det	
Mean	708,272.8		223,446.6		117,474.1		44,224.1		17,595.6	
R Square	0.956853		0.986099		0.957843		0.929969		0.914062	
F Test	<.0001		<.0001		<.0001		<.0001		<.0001	
	Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Intercept	1,075,014.8	<.0001	84,986.5	<.0001	236,658.8	<.0001	87,124.3	<.0001	37,481.0	<.0001
Mix 1	179,716.7	<.0001	44,652.1	<.0001	23,775.0	<.0001	20,200.8	<.0001	10,270.2	<.0001
Mix 2	147,424.5	<.0001	39,809.4	<.0001	20,583.3	<.0001	14,579.1	<.0001	7,123.3	<.0001
Mix 3	60,674.5	<.0001	23,367.4	<.0001	11,155.6	<.0001	1,514.6	0.1985	0.0	1.0000
Mix 4	31,096.5	0.0032	12,438.8	<.0001	5,009.0	0.0124	763.8	0.5149	0.0	1.0000
Utilization Rate	7,241.0	<.0001	2,293.4	<.0001	1,201.4	<.0001	442.9	<.0001	175.1	<.0001
Operation Mode	-11,036.4	<.0001	-246.1	<.0001	-2,670.1	<.0001	-851.1	<.0001	-352.8	<.0001
UR^2	-2.0	0.9350	0.0	0.9916	-0.2	0.9609	-0.7	0.7939	-0.4	0.7910
OM^2	0.0	1.0	0.0	1.0	0.0	1.0	0.0	0.9999	0.0	0.9999

	Inf Regt		LAR Bn		Recon Co		Tank Bn	
Mean	85,439.7		32,441.5		3,914.2		183,737.0	
R Square	0.939217		0.937411		0.965417		0.955287	
F Test	<.0001		<.0001		<.0001		<.0001	
	Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Intercept	170,435.8	<.0001	67,785.7	<.0001	7,549.5	<.0001	382,993.9	<.0001
Mix 1	30,670.5	<.0001	10,643.4	<.0001	440.7	<.0001	39,064.0	<.0001
Mix 2	22,475.1	<.0001	8,128.5	<.0001	440.7	<.0001	34,285.2	<.0001
Mix 3	3,325.5	0.0896	2,130.3	0.0053	398.4	<.0001	18,782.9	<.0001
Mix 4	1,421.9	0.4642	724.8	0.3314	95.5	0.0954	10,642.7	0.0015
Utilization Rate	869.6	<.0001	332.7	<.0001	40.0	<.0001	1,885.9	<.0001
Operation Mode	-1,803.2	<.0001	-731.7	<.0001	-89.6	<.0001	-4,291.7	<.0001
UR^2	-0.5	0.9171	-0.1	0.9656	0.0	0.9641	0.0	0.9956
OM^2	0.0	1.0000	0.0	1.0000	0.0	0.9992	0.0	1.0

The inclusion of polynomial terms to the main effects model shows no change whatsoever in the R Square values. This is because all of the polynomial terms coefficients have very high p-values and thus cannot confidently be stated to be non-zero. The addition of polynomial terms to the model, therefore, was completely ineffective.

D. MAIN EFFECTS + INTERACTION TERMS + POLYNOMIAL TERMS MODEL

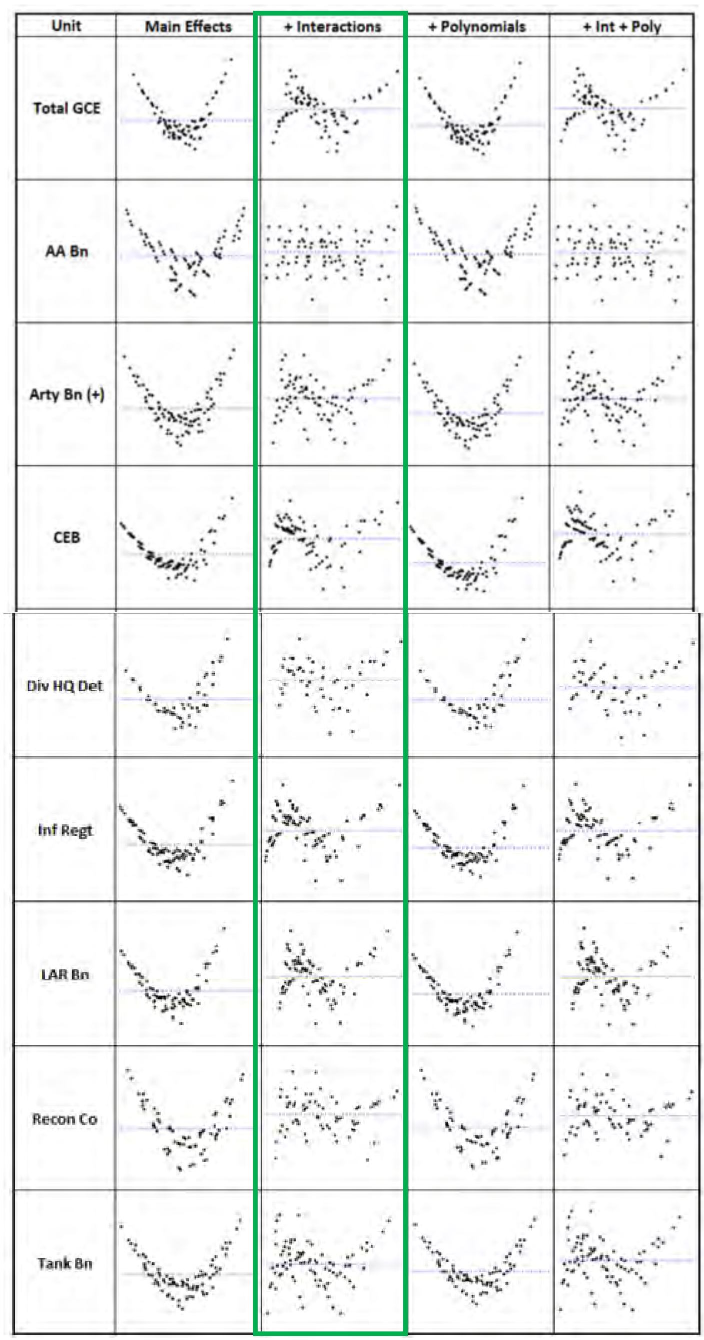
Main Effects + Interactions + Polynomials OLS Regression Summary

	Total GCE		AA Bn		Arty Bn(+)		CEB		Div HQ Det	
Mean	708,272.8		223,446.6		117,474.1		44,224.1		17,595.6	
R Square	0.999368		0.999973		0.999524		0.998495		0.997942	
F Test	<.0001		<.0001		<.0001		<.0001		<.0001	
	Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Intercept	1,129,580.8	<.0001	22,247.0	<.0001	261,858.4	<.0001	97,921.8	<.0001	43,351.2	<.0001
Mix 1	179,716.7	<.0001	44,652.1	<.0001	23,775.0	<.0001	20,200.8	<.0001	10,270.2	<.0001
Mix 2	147,424.5	<.0001	39,809.4	<.0001	20,583.3	<.0001	14,579.1	<.0001	7,123.3	<.0001
Mix 3	60,674.5	<.0001	23,367.4	<.0001	11,155.6	<.0001	1,514.6	<.0001	0.0	1.0
Mix 4	31,096.5	<.0001	12,438.8	<.0001	5,009.0	<.0001	763.8	<.0001	0.0	1.0
Utilization Rate	9,737.1	<.0001	3,015.3	<.0001	1,562.2	<.0001	657.7	<.0001	275.7	<.0001
Operation Mode	-15,038.7	<.0001	-370.5	<.0001	-3,476.4	<.0001	-1,275.8	<.0001	-562.4	<.0001
UR^2	-2.0	0.5298	0.0	0.8212	-0.2	0.6672	-0.7	0.0997	-0.4	0.1134
OM^2	0.0	1.0000	0.0	1.0000	0.0	0.9999	0.0	0.9997	0.0	0.9995
Mix 1*UR	1,772.1	<.0001	445.1	<.0001	235.1	<.0001	193.2	<.0001	98.2	<.0001
Mix 1*OM	-2,969.0	<.0001	-117.8	<.0001	-513.8	<.0001	-381.4	<.0001	-206.3	<.0001
Mix 2*UR	1,466.5	<.0001	398.1	<.0001	204.6	<.0001	141.9	<.0001	69.4	<.0001
Mix 2*OM	-2,386.2	<.0001	-83.5	<.0001	-452.0	<.0001	-276.6	<.0001	-143.0	<.0001
Mix 3*UR	604.5	<.0001	233.2	<.0001	110.6	<.0001	15.1	0.1216	0.0	1.0
Mix 3*OM	-876.6	<.0001	-6.1	0.1162	-260.5	<.0001	-31.9	0.0111	0.0	1.0
Mix 4*UR	317.0	<.0001	126.8	<.0001	51.0	<.0001	7.8	0.4211	0.0	1.0
Mix 4*OM	-438.7	<.0001	0.0	0.9989	-117.5	<.0001	-18.0	0.1453	0.0	1.0
UR*OM	-113.4	<.0001	-2.5	<.0001	-27.4	<.0001	-8.8	<.0001	-3.6	<.0001

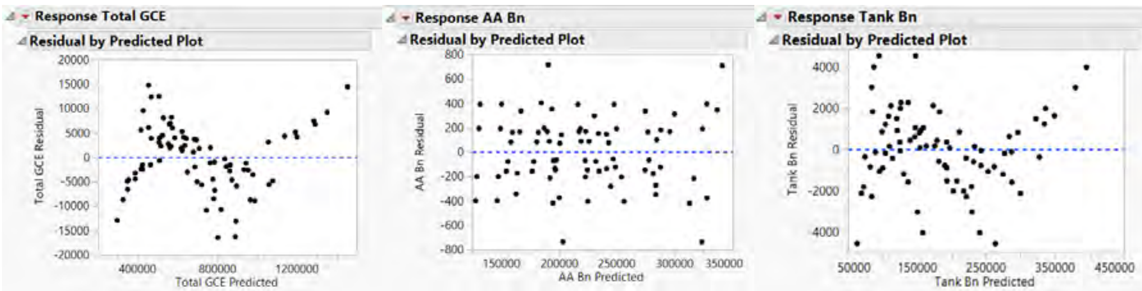
	Inf Regt		LAR Bn		Recon Co		Tank Bn	
Mean	85,439.7		32,441.5		3,914.2		183,737.0	
R Square	0.998869		0.998825		0.99978		0.999444	
F Test	<.0001		<.0001		<.0001		<.0001	
	Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Intercept	188,954.9	<.0001	76,863.1	<.0001	8,176.6	<.0001	430,209.5	<.0001
Mix 1	30,670.5	<.0001	10,643.4	<.0001	440.7	<.0001	39,064.0	<.0001
Mix 2	22,475.1	<.0001	8,128.5	<.0001	440.7	<.0001	34,285.2	<.0001
Mix 3	3,325.5	<.0001	2,130.3	<.0001	398.4	<.0001	18,782.9	<.0001
Mix 4	1,421.9	<.0001	724.8	<.0001	95.5	<.0001	10,642.7	<.0001
Utilization Rate	1,212.3	<.0001	462.4	<.0001	48.1	<.0001	2,503.5	<.0001
Operation Mode	-2,497.8	<.0001	-1,021.8	<.0001	-108.5	<.0001	-5,725.6	<.0001
UR^2	-0.5	0.4770	-0.1	0.7690	0.0	0.5994	0.0	0.9634
OM^2	0.0	0.9999	0.0	1.0000	0.0	0.9902	0.0	0.9998
Mix 1*UR	300.4	<.0001	106.1	<.0001	4.3	<.0001	389.7	<.0001
Mix 1*OM	-600.9	<.0001	-236.1	<.0001	-10.1	<.0001	-902.6	<.0001
Mix 2*UR	223.2	<.0001	81.7	<.0001	4.3	<.0001	343.3	<.0001
Mix 2*OM	-445.0	<.0001	-181.0	<.0001	-10.1	<.0001	-795.1	<.0001
Mix 3*UR	33.0	0.0294	20.9	0.0005	3.9	<.0001	187.7	<.0001
Mix 3*OM	-78.3	<.0001	-49.2	<.0001	-9.1	<.0001	-441.6	<.0001
Mix 4*UR	14.5	0.3315	7.4	0.2002	1.0	0.0003	108.5	<.0001
Mix 4*OM	-33.5	0.0795	-17.1	0.0215	-2.2	<.0001	-250.5	<.0001
UR*OM	-18.6	<.0001	-7.5	<.0001	-0.9	<.0001	-44.1	<.0001

Again, the polynomial terms are insignificant in this model. The R Square values are above .99 due to the inclusion of the interaction terms. Therefore, the interaction terms + main effects model is preferred over this model.

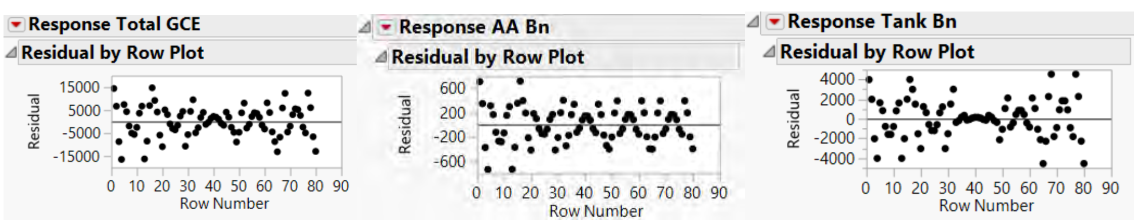
Residual vs. Predicted Plots Comparison



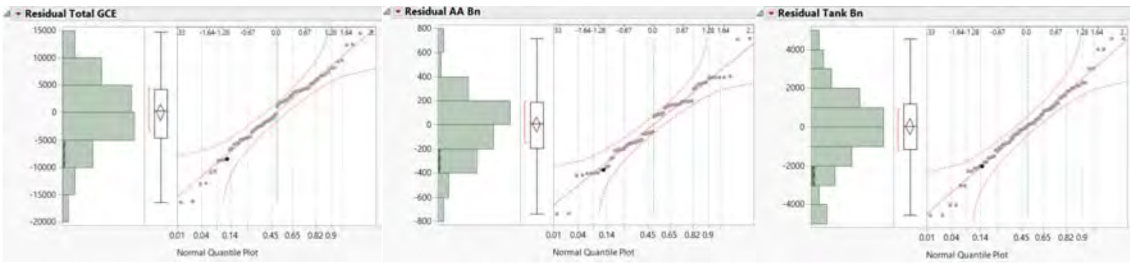
Comparison of the Residual vs. Predicted plots shows that the addition of interaction terms reduces the parabolic and conical trends that are present in the main effects model. A less correlated plot of residuals is the result of more constant variance, and thus indicative of a better model.



A second validation step is to plot the residuals by row to ensure that the data does not exhibit correlation based on its position in the data set. These plots (shown below) show a wave-like pattern that would typically be cause for concern. In this particular case, however, this is simply the result of the systematic collection and organization of the data. The rows in the original data table could easily be randomized without losing fidelity to show normality in the residual by row plot.



A third model validation step is to analyze the normal probability plot of the residuals. Ideally the residuals will align closely with the center line of the graph and the histogram on the left will be normally distributed around zero. The plots below show that both of these requirements are adequately met and thus the residuals qualify as sufficiently normal.



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APPENDIX D. CONNECTORS & CAPACITY CALCULATIONS

THROUGHPUT (TON-MILES/DAY)

Assuming 20 nm Seabase Distance *p16

		CH-53K	MV-22	SSC	SC(X)R	
A)	Ton-Miles per Crew Day (Total)	42,181	42,249	53,649	43,586	*p49 Fig 5-40
B)	Connector Quantity	7	20	10	4	*p16
C)	Ton-Miles per Crew Day (Each)	6,026	2,112	5,365	10,897	= A/B
D)	Cargo Capacity Each (Tons)	18	6.25	74	170	*p16-17
E)	Miles per Crew Day (Each)	335	338	72	64	=C/D
F)	40 nm Loops per Crew Day	8.37	8.45	1.81	1.60	=E/40

*Source: MAGTF Lift & Distribution Study

Using the above data presented in the MAGTF Lift & Distribution Study (United States Marine Corps, 2015), a few simple calculations were performed in order to apply the same assumptions to this study's throughput analysis.

	Weight (lbs)	Optimized #	Roundec	# Fuel (gal)	Fuel (lbs)	Total Weight (lbs)	Capacity (lbs)
B2085 Six-Con	2820			900	6,120		
CH-53K		4.09	4	3,600	24,480	35,760	36,000
MV-22		1.99	1	900	6,120	8,940	12,500
SSC		16.99	16	14,400	97,920	143,040	148,000
SC(X)R		37.80	37	33,300	226,440	330,780	340,000
B0570 500 Gal Bladder	270			500	3,400		
CH-53K		9.60	9	4,500	30,600	33,030	36,000
MV-22		3.60	3	1,500	10,200	11,010	12,500
SSC		40.25	40	20,000	136,000	146,800	148,000
SC(X)R		91.75	91	45,500	309,400	333,970	340,000
B0574 20k Gal Bladder	805		0	20,000	136,000		
CH-53K		0.00	0	-	-	-	36,000
MV-22		0.00	0	-	-	-	12,500
SSC		1.80	1	20,000	136,000	136,805	148,000
SC(X)R		2.80	2	40,000	272,000	273,610	340,000

The above calculations aim to identify an accurate cargo fuel capacity of each type of connector. The optimized number of containers data was solved using a simple linear programming approach to maximize the quantity of fuel that each connector can move while accounting for the container weight without violating the connector's cargo capacity.

B2085 Six-Con	40 nm Loops per Crew Day	Fuel (gal)	Quantity of Connectors	Throughput per Day (Gal)	30 day Throughput (Gal)
CH-53	8.37	3,600	18	542,327	16,269,814
MV-22	8.45	900	43	327,007	9,810,218
SSC	1.81	14,400	12	313,194	9,395,825
SC(X)R	1.60	33,300	3	160,082	4,802,472
			MEB Total	**1,342,611**	**40,278,329**

B0570 500 Gal Bladder	40 nm Loops per Crew Day	Fuel (gal)	Quantity of Connectors	Throughput per Day (Gal)	30 day Throughput (Gal)
CH-53	8.37	4,500	18	677,909	20,337,268
MV-22	8.45	1,500	43	545,012	16,350,363
SSC	1.81	20,000	12	434,992	13,049,757
SC(X)R	1.60	45,500	3	218,731	6,561,936
			MEB Total	**1,876,644**	**56,299,324**

B0574 20k Gal Bladder	40 nm Loops per Crew Day	Fuel (gal)	Quantity of Connectors	Throughput per Day (Gal)	30 day Throughput (Gal)
CH-53	8.37	-	18	0	0
MV-22	8.45	-	43	0	0
SSC	1.81	20,000	12	434,992	13,049,757
SC(X)R	1.60	40,000	3	192,291	5,768,735
			MEB Total	**627,283**	**18,818,492**

500 & 20k Gal Bladders	40 nm Loops per Crew Day	Fuel (gal)	Quantity of Connectors	Throughput per Day (Gal)	30 day Throughput (Gal)
CH-53	8.37	4,500	18	677,909	20,337,268
MV-22	8.45	1,500	43	545,012	16,350,363
SSC	1.81	21,500	12	467,616	14,028,489
SC(X)R	1.60	49,000	3	235,557	7,066,701
			MEB Total	**1,926,094**	**57,782,820**

The above data places the previous calculations into an operation context by accounting for the number of each connector type present in the full MEB as well as the distance each connector can travel given speed and crew-day constraints. In this operational context, it is clear that the use of the six-con system restricts the quantity of fuel that can be moved due to the heaviness of its steel frame construction. The use of the 500 gallon bladder system allows for over 500,000 additional gallons to be moved per day as compared to using the six-con systems. The use of the 20k gallon bladder proved effective in increasing the amount of fuel that could be transported by surface connectors, but it was too heavy to be lifted by vertical connectors. Therefore, an additional approach allowed for the use of both bladder systems and resulted in the additional transportation of approximately 50,000 gallons per day as compared to the use of only 500 gal bladders. It is the data resulting from this final approach that is used in feasibility.

APPENDIX E. FEASIBILITY OF SHIP TO SHORE FUEL MOVEMENT

	% OF TOTAL CAPACITY REQUIRED TO MEET DAILY DEMAND					
	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	
High UR (1)	2.5%	2.4%	1.9%	1.7%	1.5%	High OM (1)
	2.2%	2.1%	1.6%	1.5%	1.3%	Med High OM (2)
	1.7%	1.5%	1.2%	1.1%	1.0%	Med Low OM (3)
	1.4%	1.3%	1.0%	0.9%	0.8%	Low OM (4)
Med High UR (2)	2.2%	2.1%	1.6%	1.5%	1.3%	High OM (1)
	2.0%	1.8%	1.4%	1.3%	1.2%	Med High OM (2)
	1.5%	1.4%	1.1%	1.0%	0.9%	Med Low OM (3)
	1.2%	1.1%	0.9%	0.8%	0.7%	Low OM (4)
Med Low UR (3)	1.8%	1.7%	1.3%	1.2%	1.1%	High OM (1)
	1.6%	1.5%	1.2%	1.1%	1.0%	Med High OM (2)
	1.2%	1.1%	0.9%	0.8%	0.7%	Med Low OM (3)
	1.0%	0.9%	0.7%	0.7%	0.6%	Low OM (4)
Low UR (4)	1.5%	1.4%	1.1%	1.0%	0.9%	High OM (1)
	1.3%	1.2%	1.0%	0.9%	0.8%	Med High OM (2)
	1.0%	0.9%	0.7%	0.7%	0.6%	Med Low OM (3)
	0.8%	0.8%	0.6%	0.5%	0.5%	Low OM (4)

This table shows the percentage of total connector capacity (using both 20k and 500 gal bladder systems) that must be dedicated solely to fuel transportation in order to meet the average daily demand of each of the 80 MPEM demand models.

	# OF FEASIBLE DAYS GIVEN	1.1%	DEDICATION		21,500.00 gal	
	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	
High UR (1)	1	2	3	7	8	High OM (1)
	1	2	3	8	10	Med High OM (2)
	2	3	8	10	16	Med Low OM (3)
	3	5	18	18	22	Low OM (4)
Med High UR (2)	1	2	3	8	10	High OM (1)
	2	3	4	8	13	Med High OM (2)
	2	4	16	16	20	Med Low OM (3)
	3	7	24	24	26	Low OM (4)
Med Low UR (3)	2	3	6	9	15	High OM (1)
	2	4	11	12	18	Med High OM (2)
	3	7	25	25	27	Med Low OM (3)
	30	30	30	30	30	Low OM (4)
Low UR (4)	2	4	16	16	20	High OM (1)
	3	5	20	20	23	Med High OM (2)
	23	29	30	30	30	Med Low OM (3)
	30	30	30	30	30	Low OM (4)

The number of feasible days when 21,500 gallons are transported per day (assuming no inventory) are shown for each MPEM model. This is a significant quantity of fuel because it represents the capacity of a single SSC. Therefore, the dedication of one SSC for fuel transport will satisfy 16 percent of the models created.

	# OF FEASIBLE DAYS GIVEN		2.5%	DEDICATION	49,000.00 gal	
	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	
High UR (1)	3	9	28	28	29	High OM (1)
	30	30	30	30	30	Med High OM (2)
	30	30	30	30	30	Med Low OM (3)
	30	30	30	30	30	Low OM (4)
Med High UR (2)	30	30	30	30	30	High OM (1)
	30	30	30	30	30	Med High OM (2)
	30	30	30	30	30	Med Low OM (3)
	30	30	30	30	30	Low OM (4)
Med Low UR (3)	30	30	30	30	30	High OM (1)
	30	30	30	30	30	Med High OM (2)
	30	30	30	30	30	Med Low OM (3)
	30	30	30	30	30	Low OM (4)
Low UR (4)	30	30	30	30	30	High OM (1)
	30	30	30	30	30	Med High OM (2)
	30	30	30	30	30	Med Low OM (3)
	30	30	30	30	30	Low OM (4)

The number of feasible days when 49,000 gallons are transported per day (assuming no inventory) are shown for each MPEM model. This is a significant quantity of fuel because it represents the capacity of a single SC(X)R. Therefore, the dedication of one SC(X)R for fuel transport will satisfy 94 percent of the models created.

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